FOUNDRY TRADE JOURNAL

Established 1902

Vol. 97 Thursday, September 23, 1954 No. 1986

PRINCIPAL CONTENTS

	Page
Features	
Leader: Qualifications	341
Congress Paper Author	342
Publications Received	362
Forthcoming Events (Advert. section)	35
Technical	
Founding of Marine Propellers, by J. M. Langham	343
Cupola Discussions	349
Electric-induction Furnace on Industrial Frequency for the Production of Cast Irons, by Aldo Tagliaferri and Claude Barbazanges ...	355
News	
Public Works and Municipal Services	342
International Foundry Congress in London ...	342
John Yuille Extensions	342
Automatic Factories in Sight	348
Advisory Research	348
Personal and Obituary	363
News in Brief	364
Raw Material Markets	370
Statistics	
Pig Iron and Steel Production	368
Current Prices of Iron, Steel and Non-ferrous Metals (Advert. section)	34

PUBLISHED WEEKLY: Single Copy, 9d. By Post 11d. Annual Subscription, Home 40s. Abroad 45s. (Prepaid).

49 Wellington Street, London, W.C.2. 'Phone: Temple Bar 3951 (Private Branch Exchange) Grams: "Zacatecas, Rand, London"

Qualifications

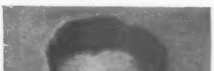
In some quarters, a plea is being made for the award of a degree to be made to successful students who have studied factory management at a university. The most important attribute of a professional qualification is its effect towards the elimination of the unqualified, when posts become vacant. In the case of some professions, such as medicine and law, the unqualified are *ipso facto* excluded. It is patent that in the case of the factory manager, two separate branches of knowledge are essential for his successful holding of that position. Primarily, he must be qualified or experienced in the technology of his industry—be it brewing, dyeing, or foundry practice. His second qualification must cover a knowledge of a number of subjects—to embrace the Factory Acts and trade union wages awards—and may usefully include costings, mechanical handling, time- and motion-study, personnel welfare and industrial accident prevention, and the like. Primarily, also, a manager must be psychologically suited to the exercise of that title. In a large concern, some of these aspects can well be left to subordinates. From this angle, there is no call for an additional professional qualification, which at the best could only be regarded as an acknowledgment of the fact that a study had been made of subjects germane to the *theory* of management.

The technical qualification for a works or departmental manager is usually based—and rightly so—on a combination of theory and practice, as the technical institutes in the main insist on a considerable period being spent in practical work, before accepting a candidate for membership. Quite often, an exception is made where the high position in industry held by the applicant is of itself ample qualification. Industry is so complicated that there is no common denominator upon which to dogmatize. The very word "factory" is not subject to clear definition as it was some years ago, when the existence of power-driven machinery differentiated a factory from a workshop. The duties of a factory manager can never be precisely stated. In the largest concerns, so many of his duties are delegated that he has a full-time job in making decisions on problems found too difficult to be resolved by his numerous assistants. At the other end of the scale, the works manager may be found with his jacket off, mending a machine, or showing a man a better way of doing a job.

There is a vast difference between the law of the land and the amateur who has notions of legislating for industry or even a section of it. The law is only too often wrongly designated "an ass" because it correctly takes care of the minority, whilst an amateur proposing legislation seldom makes any effort to establish the boundaries of his field of endeavour. There is too little realization of the great effort that has been made by the great national technical institutes in co-operation with the Ministry of Education to award qualifications the import of which is known and appreciated by those in search of executive personnel. Such qualifying procedures are an established part of British industrial life and, not being too static, are best left alone—from the glamorous F.R.S. down to the simple R.P.

Conference Paper Author

Mr. John M. Langham, M.A., whose Paper on the manufacture of marine propellers (presented at the Florence International Foundry Congress) is printed elsewhere in this issue, was educated at Bedford School and Queens' College, Cambridge University, taking the Mechanical Sciences Tripos. Subsequently, he underwent practical training at Harland & Wolff, Limited, Belfast, and served for three years as an engineer officer in the Royal Navy. In 1947, he joined J. Stone & Company, Limited, and in 1951 became marine production manager at their Charlton Works, engaged in the manufacture of all types of ships' propellers and other marine equipment, involving casting machinery and completion of the finished product.



Mr. Langham is a member of the Institute of British Foundrymen and an associate member of the Institution of Mechanical Engineers and the Institute of Marine Engineers. He travelled personally to Florence to deliver the Paper, which formed the official Exchange Paper of the Institute of British Foundrymen.

International Foundry Congress in London

The International Foundry Congress in June, 1955, will be held in London under the auspices of the Institute of British Foundrymen and it is desired to form a panel of host/interpreters who are prepared to volunteer services in this capacity during the period of the congress.

The duties of the host/interpreters will be to assist foreign delegates generally. It is also hoped that some of them might render special services to delegates and their ladies in the form of accompanying them on, for instance, shopping expeditions.

It will be appreciated if members and their wives who are qualified to act in this capacity will forward their names to the secretary of the Institute for enrolment on the panel. When writing, it is requested that information be given on the languages spoken and the duties which could be undertaken.

Index to Vol. 96

The index to the JOURNAL, volume 96, covering the period January 7 to June 24, 1954, has now been printed and is available to readers free of charge. Applications for copies should be addressed to the publishing office, FOUNDRY TRADE JOURNAL, 49, Wellington Street, London, W.C.2. Subscribers who wish to receive copies of indices automatically as they are printed may apply for inclusion on a permanent mailing list. Those already on this list should not need to apply for their current copy.

TO MAKE more land available for industrial development, the Wear and Tees River Board is to carry out large-scale flood protection works on the banks of the Tees.

Public Works and Municipal Services

Last week full details were given of the Public Works and Municipal Services Congress and Exhibition to be held at Olympia from November 15 to 20. Particulars of further exhibitors, whose plant and equipment has considerable interest for the foundryman, are given below.

PETROL, vaporizing oil and Diesel engines with a multitude of uses form the main part of the display by R. A. Lister & Company, Limited, of Dursley. Particular interest will be centred on this firm's new LD air-cooled engine of 1½/3½ h.p. which has been described as the engine with a hundred uses (stand 67).

F. E. WEATHERILL, LIMITED (stand 59), are exhibiting for the first time a new hydraulic loading shovel. This machine, with 1 cub. yd. bucket mounted on full track and powered by a 4-cylinder Diesel engine, will, it is claimed, fulfil the need for equipment comparable to, but considerably lower in price, than American equivalents.

JET CONVEYORS from the factory of George Pike, Limited, in Birmingham, are being exhibited for the first time. These machines are easily transportable and are capable of throwing dry or wet sand, shale, gravel, etc., distances of 6 to 20 yards at a rate of 35 to 60 bulk tons an hour. They are powered by either petrol or Diesel engines (stand 48).

FIVE NEW MACHINES are exhibited by Aveling-Barford, Limited, of Grantham on stand 72. These are a roller, tandem, Diesel-type "TR" for black-top finishing; a roller, Diesel-type "GFX", weight 3½ or 2½ tons; a dumper, Diesel-type "SL", 7½ cub. yd. capacity; a dumper, Diesel-type "SF", 3 cub. yd. capacity, and a maintenance grader with a 42.5 b.h.p. Diesel engine.

John Yuille Extensions

With the growth of light engineering industries in Scotland, set up to balance the heavy trades, the demand for precision tools has increased considerably. As the production of these items lags appreciably behind requirements, manufacturers have frequently to place their orders south of the border, and in many instances the delivery position is most unfavourable. This reacts on production programmes and creates delays which could be avoided if precision tools were more readily obtainable in Scotland. John Yuille (Metal Works), Limited, Hillington, Glasgow, manufacturers of air filters, dust extraction/collection equipment, conveyors, and elevators, after studying the potential needs of numerous industries in Scotland, have decided to extend their activities to include a tool-room, which is now in production. Their aim is to produce press tools, jigs, fixtures, and gauges equal—if not surpassing—in finish any obtainable elsewhere and with a guaranteed delivery date.

The venture has already received support from a number of industries in Scotland, and production at present includes press tools, jigs, and fixtures used in the manufacture of refrigeration plant, typewriters and various other types of office machinery, aero-engines, and agricultural machinery. To accommodate the additional technical and drawing office staff required by the inauguration of the tool-room the firm have found it necessary to extend their premises, for which they have obtained the necessary Board of Trade sanction, and construction is now making good progress.

Founding of Marine Propellers*

By John M. Langham, M.A., A.M.I.Mech.E., A.I.Mar.E.

This Paper endeavours to provide an up-to-date and complete review of current methods of manufacturing marine propellers with particular reference to foundry technique as developed by the Author's company. The three principal types—the built, the solid and the controllable pitch propeller—are described. The Charlton foundry of J. Stone & Company, which uses the Randupson sand/cement process for moulding, is described in detail, with particular reference to the elaborate sand plant and sand-handling arrangements, the heavy crane capacity and melting facilities and the layout of the floor-level and pit-moulding sites. This modern foundry with all its equipment has been built and is used exclusively for the casting of marine bronze propellers. With its floor area of 36,000 *sq. ft., it is probably the largest and most specialized of its type in the world.*

Introduction

During the last 50 years, methods of ship propulsion have been the subject of great progress and the design and manufacture of propellers has developed accordingly. Originally, these were of simple shape, made in cast iron or steel usually by the engine builders' own foundry, and fitted to the shaft in the as-cast condition, except for machining the bore. To-day, as a result of constant demands for greater propulsive efficiency, the subject of propellers has become highly complex and consequently there is now a strong tendency to delegate the entire matter to organizations who have made a special study of ship propulsion. There exist various experimental tanks in which model tests of any proposed propeller and hull may be carried out as well as design projects, and there are several specialist engineering companies which maintain large design and research departments in conjunction with modern, specially equipped works capable of manufacturing propellers of any design and size to the highest standards. It is interesting to note that the great majority of bronze propellers produced in Europe are manufactured by these companies and the major proportion is designed by them as well.

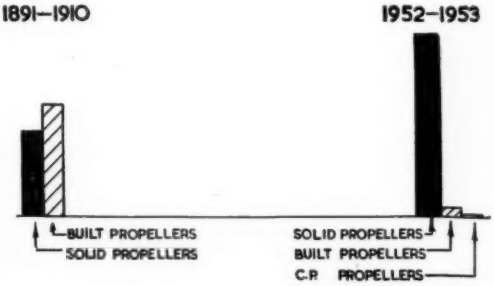
Types of Propeller

There are three principal types now manufactured —built, solid and controllable-pitch propellers— each usually having three, four or five blades. Statistics compiled from the records of the Author's company (see Table I and Fig. 1) show unmistakably the gradual replacement of the built type of propeller by solid ones which has taken place during the last 60 years and, more significantly, the relatively recent appearance of controllable-pitch propellers, which may well replace the solid type to a considerable extent in certain applications in the foreseeable future.

The built propeller has the blades and hub cast and machined separately. It is assembled by bolting each blade to a seating on the hub and fairing the protruding nuts with cement. It has the advantage that if a blade is damaged it can easily be replaced without removing the whole propeller from the shaft. In addition, small adjustments to the pitch of the blades can be made if found necessary, as the holes for the holding-down studs are elongated. These were the reasons for the general use of this type years ago, coupled with the fact that the sizes of solid-propeller castings which could be made by foundries at that time were limited. The main drawback is that the restricted width in the root of the blades and the additional thickness thus required to maintain equal strength, together with the relatively large hub diameter, lead to some loss in efficiency and it is principally for this reason that this type is now little used.

The solid propeller, having blades cast integrally with the hub, has developed from the simple uniform-pitch and radial-section design (Fig. 2) to the present modern, high-efficiency design, incorporating non-uniform pitch and aerofoil sections (Fig. 3). Even more complicated designs featuring, in addition, concave and radial-pitch faces are now becoming more general. Concurrent with the development of these latter designs have come demands from designers for special manufacturing tolerances. Solid propellers of all designs having a finished weight of up to 30 tons (*i.e.,* a cast weight of up to 50 tons) are regularly manufactured to fine tolerances, whilst in the near future it is anticipated that propellers up to 50 per cent. heavier will not

FIG. 1.—*Trends of propeller production over half a century.*



* British Exchange Paper presented to the International Foundry Congress in Florence this week. It was previously read before the London branch of the Institute of British Foundrymen. The Author is marine production manager at the Charlton works of J. Stone & Company, Limited.

be unusual. It will be appreciated that the casting, machining and finishing operations present considerable difficulties and it is with this type of propeller that this Paper is concerned.

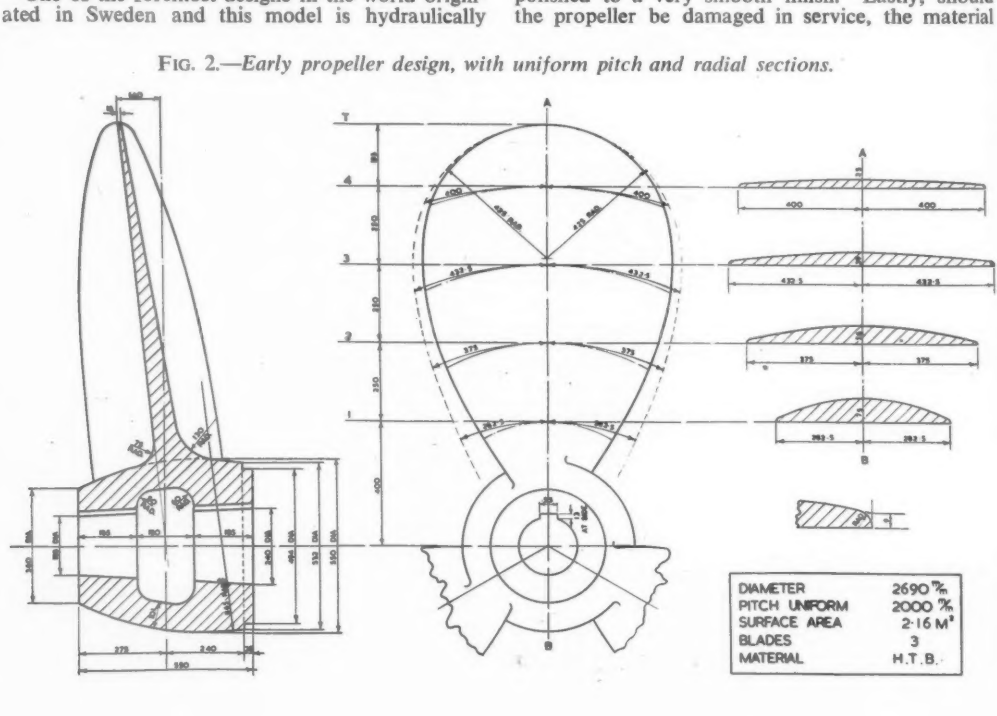
The controllable-pitch propeller, as it is known to-day, is a comparative newcomer and is already making considerable progress. It is the outcome of development which has taken place, more particularly in recent years, to cater for new methods of propulsion and to provide greater flexibility, manœuvrability and efficiency for certain classes of "dual-purpose" vessels. As its name implies, the pitch can be altered as required to suit prevailing resistance conditions and also to give reverse thrust. This is done by rotating each blade about its axis either by hydraulic or mechanical means. All the necessary control gear is inboard and the actuating mechanism is contained inside the shaft and hub. Such a propeller can usually be controlled instantaneously direct from the bridge with the engine running at normal revolutions. Thus the ship can be moved at any desired speed from full ahead to full astern without a reversing gearbox and without any action on the part of the engine-room personnel. Applications for this type include tugs and trawlers (where operating conditions when towing or running free are entirely different), ferries and warships (where manœuvrability is important) and vessels with uni-directional prime-movers, notably those to be fitted in the future with gas turbines.

One of the foremost designs in the world originated in Sweden and this model is hydraulically operated. Controllable-pitch propellers of this type, as well as others embodying mechanical operation, are now in full-scale production at the Author's works for a wide range of applications. One of these was recently installed in the first British-built, Diesel-engined whalecatcher—the Setter IX. This propeller, shown diagrammatically in Fig. 4 and on test in Fig. 5, absorbs 3,200 S.H.P. at 175 r.p.m. and can be controlled from either the bridge or the engine room by pneumatic means. Its manufacture presented many interesting problems, not only in the machining and assembly operations but also in the foundry. For example, the bronze hub casting, weighing 42 cwt. when finished, and requiring a charge weight of 105 cwt., is intricate and is subjected to a test pressure of 500 lb. per sq. in. Fig. 6 shows the sand/cement mould for this principal component in the course of construction.

Propeller Materials

A number of important factors have to be considered when selecting a suitable material for the manufacture of propellers. The mechanical properties must be adequate to meet the service stresses imposed by the design, whilst the material must be satisfactorily resistant to corrosive and erosive attacks. It must be suitable for melting in large quantities without susceptibility to melting troubles, such as gassing, and it must have the necessary casting qualities. The machinability is particularly important, as the whole of the large surface of the casting has to be accurately machined, ground and polished to a very smooth finish. Lastly, should the propeller be damaged in service, the material

FIG. 2.—*Early propeller design, with uniform pitch and radial sections.*



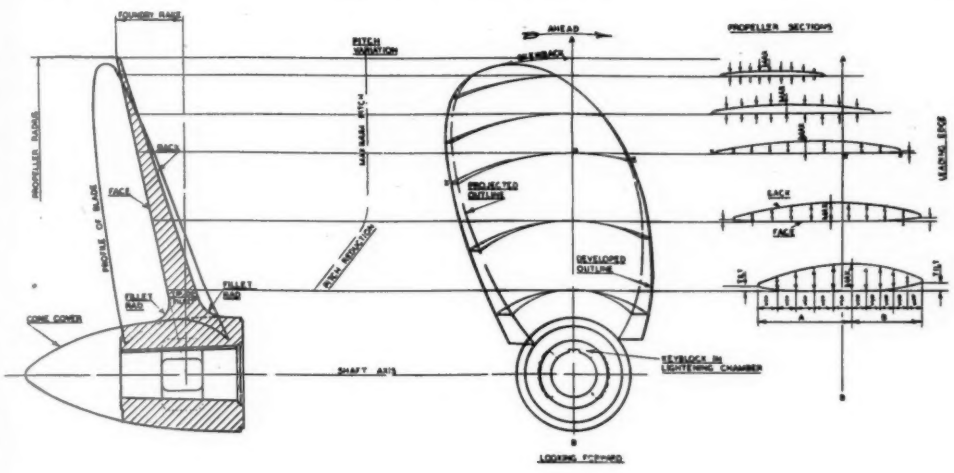


FIG. 3.—*Modern propeller design, with non-uniform pitch and aerofoil sections.*

must be capable of being repaired by straightening, electric welding or "burning" in the foundry.

For optimum service performance, it is necessary to reduce sections to the minimum thickness consistent with maintaining adequate strength and also to ensure that the surfaces of the blades remain smooth under all corrosive and erosive influences. For these reasons, high-tensile brass has to-day largely superseded cast iron, which was in general use 50 years ago. However, in an endeavour to reduce sections still further and also to improve resistance to fatigue and surface attack, other stronger materials both ferrous and non-ferrous have been used and are being developed. Table II shows comparative mechanical and physical properties whilst Table III gives comparative fatigue properties for different propeller alloys.

Cast Iron.

Cast-iron working propellers are still used on some ships but, because it is necessary to have thicker sections to allow for the low strength, their efficiency is reduced by comparison with those made of high-tensile brass. In addition, the blade surfaces very rapidly deteriorate because of low resistance to corrosion and erosion. They are, of course, far less expensive and for this reason they are frequently carried as spares.

High-tensile Brass.

Commonly known as manganese-bronze, this alloy is now almost universally used for propellers as it combines relatively high strength with ductility and good corrosion/erosion resistance. It is basically a 60/40 copper/zinc alloy, with small amounts of manganese and iron, aluminium and tin which are added to effect grain refinement, to increase tensile strength and to improve corrosion resistance. It is relatively easy to cast, machine and repair. Fig. 7 shows a large, five-bladed, high-tensile-brass propeller.

Stainless Steel.

In recent years, stainless steel propellers have been used experimentally in the U.K. and to a greater extent in Scandinavia. The 13 per cent. chromium alloy possesses high strength and corrosion resistance, but relatively only a very low corrosion fatigue value. Experience has shown that it is difficult to cast and to machine satisfactorily and that considerable distortion is liable to occur, not only during cooling, but also during subsequent heat-treatments. For these reasons, stainless steel is not a very economic proposition when manufacturing propellers to normal tolerances and in any case it falls short of the special copper alloys for modern requirements.

Special Alloys.

In recent years several special high-strength non-ferrous alloys have been developed for and applied to propellers. Aluminium-bronze containing nickel has been used quite extensively but, whilst it has physical properties superior in many respects to high-tensile brass, it presents considerable difficulties in the foundry, particularly as far as the heavier propellers are concerned.

A new alloy has been specifically developed by J. Stone & Company (Charlton), Limited, for its excellent casting qualities and its suitability in every way for all sizes of propellers. It is a copper-base alloy, containing manganese and aluminium as the major alloying constituents, and its mechanical properties are similar to and, in certain respects, rather better than those of nickel aluminium bronze. When it is used for propellers, maximum calculated stresses can be increased above normal, thus enabling more efficient blade sections to be designed and

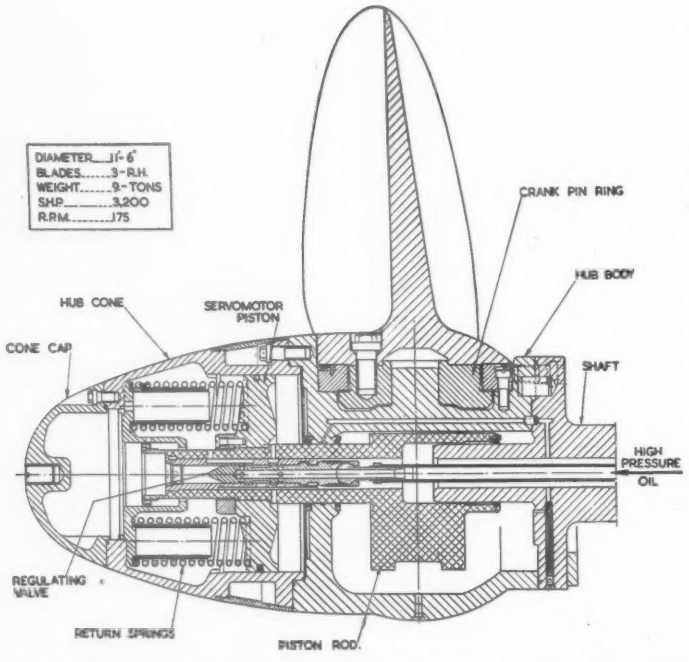


FIG. 4.—*Stone-Kamewa, controllable-pitch propeller drawing.*

this, coupled with its lower specific gravity, tends to reduce the total weight and, therefore, the moment of inertia. Propellers in this material have a superior resistance to erosion and corrosion and can be polished to a high degree of surface smoothness. Fig. 8 shows a propeller of 23 tons finished weight (35 tons cast weight) which was recently made in this alloy and much larger ones are in hand for tankers of 45,000 tons d.w.

Patterns

Usually, each propeller is of different design suitable for a particular hull form, having a particular engine, and, although shipowners have, to some extent, standardized their fleets into different classes of vessel, it is quite rare to receive an order for more than three or four off to the same design. The practice of using full patterns is, therefore, restricted, as it is uneconomic except where more than five or six off have to be made. In most cases, the blade faces and the boss are strickled to size and shape using special equipment, whilst the pattern for the blade itself is made in sand. The shape of the pattern is defined by a skeleton consisting of a series of thin wooden or metal sections spaced at intervals of radius. These section pieces are accurately made from the drawing to represent exactly the cylindrical cross sections of the blade at a series of radii, with allowances for contraction and machining.

Full patterns are employed whenever numbers off warrant their use and also in certain special cases featuring an exceptionally complicated blade design, provided several off are required. They are used quite frequently in the case of "built" blades, whilst a notable recent example of their application has been in the case of "Liberty" ships where a very large number of solid propellers of standard design have been made from one pattern. The construction of full patterns in wood has some disadvantages and the practice is, therefore, to cast them in bronze, using the strickle-moulding process with double allowance for contraction and machining and then to finish them accurately to size, plus single contraction allowances. On completion of a production run, such a pattern can either be retained against the possibility of future orders, if these are likely, or alternatively, it can easily be machined down to size and finished to complete the current order. A variation of this practice is to make a single blade-pattern which is then used to form individually the required number of blade moulds in order to complete the solid propeller in question.

FIG. 5.—*Stone-Kamewa controllable-pitch propeller on test.*

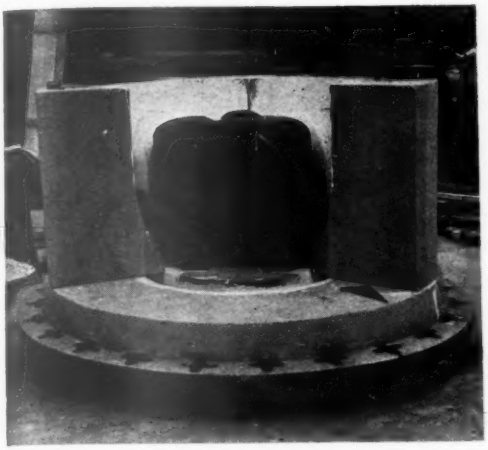


FIG. 6.—*Mould for the hub of a controllable-pitch propeller, weighing* 42 *cwt. when finished.*

Mould Materials

The latest material used for moulding is a sand/cement mixture made by the Randupson process (described by F. W. Rowe, in a paper given to the Institute of British Foundrymen, in 1938). A pure, washed silica sand of average grading between 20 and 50 mesh is well mixed with carefully controlled amounts of ordinary Portland cement and water. The resultant sub-hydrated sand/cement mixture sets after a minimum of 48-hours drying at normal shop temperatures to form a very strong and rigid mould material. It is highly refractory and permeable and, in addition, it can be easily worked and is capable of being sleeked to a fairly fine surface. As the average dry-compression strength is in excess of 200 lb. per sq. in., a mould of this material, particularly when reinforced internally with suitable iron grids, is capable of withstanding the high stresses imposed whilst casting a large propeller, and consequently it ensures very good dimensional accuracy. When the casting has been removed, the mould is broken up, and, after crushing and grading in a special plant, the material is used again as reconditioned sand. An all-new-sand mixture is used for mould surfaces which are in contact with molten metal but the body of the mould contains a good proportion of old lumps, to provide venting space and for economy, together with re-conditioned sand/cement mixture for bonding purposes.

An alternative material is loam, which was used universally prior to the introduction of sand/cement —in 1937—and is still used, with good results, in some foundries. In general, the same methods of moulding are employed, but the body of the mould is constructed of bricks bonded together with loam. As extensive artificial drying is necessary, either the

FIG. 7.—*Finished, five-bladed, high-tensile-brass propeller.*

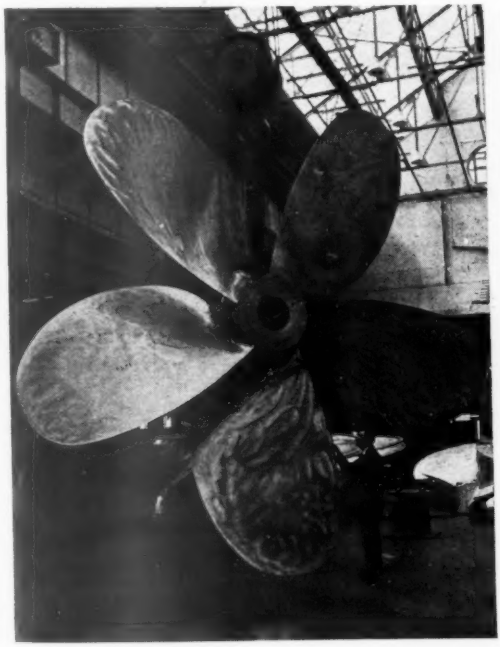
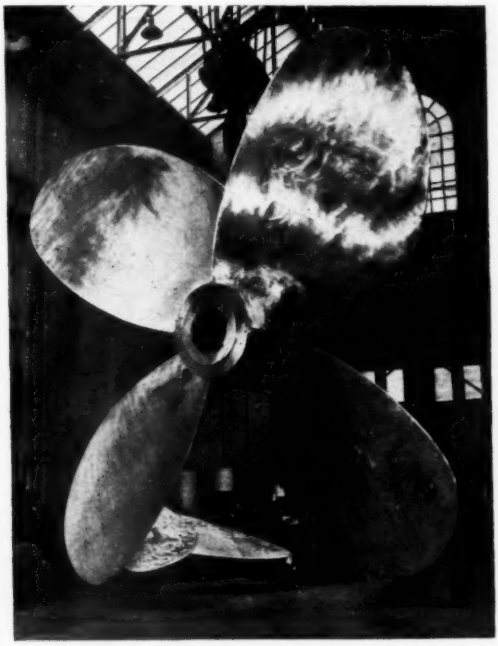


FIG. 8.—*Finished,* 23*-ton Novoston propeller.*



Founding of Marine Propellers

TABLE I.—*Propeller Production Analysis.*

Period.	Percentage by weight.		
	Solid props.	Built props.	C.-P. props.
1891–1910 ..	44.3	55.7	—
1911–1930 ..	62.8	37.2	—
1931–1940 ..	80.0	20.0	—
1946–1951 ..	89.4	10.3	0.3
1952–1953 ..	95.9	3.1	1.0

TABLE II.—*Propeller Alloys, Typical Mechanical and Physical Properties.*

Alloy.	0.15 per cent. proof stress, tons per sq. in.	Ultimate tensile stress, tons per sq. in.	Elongation, per cent.	Specific gravity.	Brinell hardness.	Liquidus deg. C.
Cast Bar:						
No. 6 H.T.B.	12.5	32	30	8.28	120/165	890
No. 4 H.T.B.	17.5	37.5	25	8.23	120/165	890
No. 2 H.T.B.	26.5	46.0	22	7.83	170/229	950
Novoston ..	20.0	44.0	23	7.50	163/210	970
Ni/Al bronze	17.6	45.0	23	7.65	156/187	1,075
Cast Prop.: 12.5 per cent. Cr steel ..	30.4	44.4	12	—	—	—

TABLE III.—*Typical Fatigue Properties of Propeller Alloys.*

Alloy.	In air.		In salt-spray.			
	20×10^6	100×10^6	20×10^6	25×10^6	50×10^6	100×10^6
	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.
Cast bar:						
No. 6 H.T.B.	12.0	11.2	8.7	—	—	6.4
No. 4 H.T.B.	11.1*	9.5*	—	—	—	—
No. 2 H.T.B.	9.8	—	8.0	—	—	6.4
Novoston ..	17.7	15.0	11.3	—	—	8.5
Ni/Al bronze	15.5	15.0	—	11.5	8.5 9.5	—
Cast Prop. 12.5 per cent. Cr. steel. ..	—	—	—	—	—	4.0

NOTE.—* Results probably on low side.

completed mould has to be transported to and from very large drying stoves or, alternatively, rather elaborate arrangements have to be made to dry the mould *in situ*. In addition, a loam mould is not exceptionally strong and, therefore, it is usually buried in a pit to provide external reinforcement during casting. Thus, by comparison with sand/cement moulding, which is all done on concrete floors—thereby ensuring a very clean foundry and which requires neither very heavy transportation facilities nor large drying stoves—it will be seen that the loam process has some disadvantages from the production point of view, apart from the fact that it does not produce quite such accurate castings.

(To be continued)

I. T. D., LIMITED, 95-99, Ladbroke Grove, London, W.11, announce that Mr. John R. S. Halford has been appointed export sales manager.

Automatic Factories in Sight

With the aid of electronic machines we are now in sight of being able to remove the boredom of routine repetitive work in industry. Already there is evidence of the appearance of the automatic factory. The implications of this development were referred to by Sir Ben Lockspeiser, secretary of the Department of Scientific and Industrial Research, at the opening session of a conference for apprentices arranged by the Industrial Welfare Society of Oxford recently. Sir Ben thought that in future there would be less and less room for the unskilled person and people would be called on more and more for creative activity which machines could not give. We should require more educated people in the broadest sense, and the demand would grow for trained technicians, engineers, and technologists.

The introduction of electronic computors would probably lead to a gradual reduction in the proportion of office workers, Sir Ben continued. The electronic computing machine could be developed to become the master controlling mechanism of an automatic factory. Examples of factories either fully automatic or almost so were beginning to make their appearance and had demonstrated the possibility of carrying out automatically the operations of the foundry, engineering shop, and inspection and packaging at less cost, employing far less labour, and with greater precision than was obtainable under manual control.

Advisory Research

Among four new members appointed to the Advisory Council for Scientific and Industrial Research is Dr. Charles Sykes, F.R.S., managing director of Thos. Firth & John Brown, Limited, the Sheffield steelmakers, since 1951. Until that year he was director of the Brown-Firth research laboratories, an appointment he had held since 1944, the year he joined the company's board. Previously, Dr. Sykes, who is 49, was superintendent of the metallurgy department at the National Physical Laboratory.

Two appointments from the universities are announced. Prof. E. A. G. Robinson, who is 56, has been Professor of Economics at Cambridge University since 1950 and became secretary of the Royal Economic Society in 1945. Dr. Eric Ashby is president and Vice-Chancellor of Queen's University, Belfast, to which he was appointed in 1950. He is a well-known botanist and lectured for some years in Australia and during his stay held several appointments on Government committees, including the chairmanship of the Australian National Research Council. Dr. Ashby was born in 1904.

The fourth new member is Mr. S. Barratt, finance director of Albright & Wilson, Limited, industrial chemical manufacturers, of Oldbury (Staffs). The retiring members of the council are Prof. R. S. Edwards, Lord Halsbury, Sir Henry Hinchliffe, and Mr. A. H. Wilson.

Discussions on Cupola Practice

At the first session of the I.B.F. conference in Glasgow, three reports on cupola practice were presented, viz.: *a sub-committee report on cupola developments, an account of operating experiences with a cupola having an electrical attachment and a report of twenty-years' working with the balanced-blast design of cupola. The discussions which ensued are reported in what follows. Taken in aggregate, the comments show the trends of cupola operation over a wide field, and the detail problems connected with day-to-day working. Emphasis on such features as compositional changes in melting, slag reactions, stringent economics, dust emission, etc., all show the greatly increased surveillance which this hitherto simple melting equipment has recently received.*

Cupola Development*

Sub-committee T.S. 43 Report

At session "A" of the fifty-first annual conference of the Institute of British Foundrymen held in Glasgow, Mr. John Bell, presided. The first technical item discussed was a report by sub-committee T.S. 43, of the Technical Council on "Cupola Development," presented by the chairman of the committee, Mr. E. S. Renshaw.

Introducing the Report, MR. RENSHAW said he thought it should be pointed out that it had been produced in a comparatively short time as the Technical Council was anxious to give assistance to foundrymen wishing to embark on some of the developments with which the Report dealt. Hence, the reason for this survey, which was intended as a forerunner to future work.

Following Mr. Renshaw's survey of the salient features from the Report, which had been preprinted, the meeting was opened for discussion.

Optimum Temperatures

MR. H. G. HALL started the discussion by enquiring what was the best temperature for secondary air in a hot-blast cupola. Looking through literature on that subject, he had noticed one or two suggestions that the higher the temperature of secondary air, the better. In other words, was a figure of 400 deg. C. typical. He, himself, was using a rotary furnace and pre-heating the air. He could go to 550 deg. C., but, quite honestly, he did not appear to get any advantage economically in using air at that temperature over using it at 400 deg. C. Could Mr. Renshaw possibly give an explanation of some of the quoted figures and the suggestion that high temperatures were not necessarily advantageous.

Secondly, did the quoted figure of refractories consumption per ton include in all cases the original lining or was it merely the running refractories cost?

MR. RENSHAW said he assumed in the question that the term "secondary air" referred to hot-blast. He did not consider that pre-heated air applied to cupola practice was strictly comparable with "secondary air" utilized in a rotary furnace. As currently designed, cupola recuperative systems in general gave pre-heated air at around 500 deg. C. Whether or not this was the optimum temperature was a matter of much debate, and practical work at higher temperatures would be required to determine any possible advantages. Further economy in coke consumption by operating with blast at higher temperatures was perhaps unlikely, but a greater degree of silicon and carbon pick-up might be anticipated.

Replying to the question on refractory consumption, the figures quoted referred to repair material only. When operating over long periods with low refractory consumption, the loss of initial lining material spread over the melting campaign would amount to a negligible quantity per ton of metal melted.

Other Experience

MR. W. J. DRISCOLL said he could contribute a short comment relating to two plants of which he had experience. In the first case, where the metal was required not to be at a high temperature, blast of 400 deg. C. appeared to be quite satisfactory. That in fact was the temperature for which the equipment was designed and it would be difficult to exceed it in the particular circumstances. In another case, where the hot-blast equipment was designed for blast at 450 deg. C., the company concerned felt strongly that a temperature of over 500 deg. C. was desirable, and happily they were in fact able to obtain blast temperatures of between 520 deg. and 540 deg. C., apparently without ill effects on the recuperator. In that case they required metal of high temperature with maximum carbon pick-up.

MR. VAN DER BEN thought the sub-committee should be complimented on the presentation of an excellent Report from the limited amount of data available. When speaking of hot blast and the economic advantages of it, Mr. Renshaw had doubted whether the reduction in coke consumption would justify the installation of such plant. Would Mr. Renshaw comment on any ideas the sub-committee might have on the question of the size of cupolas used. There was also the question of the type of metallic charge—in that connection the economic advantages were more apparent, due to the effect of the replacement of pig-iron by steel scrap.

Later, reference was made to the melting of scrap charges; he presumed charges wholly of scrap were meant. A thought which occurred in that connection was that the primary requirement of founders was the production of sound castings and he was just a little uncertain as to whether the replacement of pig-iron by steel scrap was meant or the use of cast-iron scrap in the charge. That might lead to

* Report printed in the JOURNAL, July 8 and 15, 1954.

trouble sometimes and he would like some comment on that aspect.

Mr. Renshaw, speaking of justifying the cost of a hot-blast unit, said that based on the figures given in the Report, it would be a simple matter to calculate the savings due to reduced coke consumption and from the anticipated tonnage to be melted in a given time, to determine the length of time required to pay for the equipment. It was unlikely that a case could be made for a recuperative system on a cupola, for example, melting for a single shift daily, on coke saving alone. For double-shift operation hot blast was a paying proposition. The position would obviously change should fuel costs increase.

Regarding the effect due to hot blast on the physical characteristics of the iron by the incorporation of charges using more scrap, this was an interesting and important point, but possibly outside the terms of reference of the present sub-committee.

Effect of Basic Slag

MR. J. J. SHEEHAN complimented the sub-committee on their Report and asked what was the effect of basic slag on a front slagging box? It was important because there were so many advantages in front slagging that he would like to think it could be applied to a basically-operated cupola.

MR. RENSHAW asked was Mr. Sheehan thinking in terms of obtaining a satisfactory refractory lining?

MR. SHEEHAN said he assumed refractoriness was adequate from the Report, but he was thinking of the fluidity of the slag and the type of slagging box. How did it have to be lined and what was the effect of basic slag on any such lining, and particularly the fluidity of the slag. Could the slag and metal be as readily separated as when operating with an acid slag?

MR. RENSHAW said that a number of types of continuous tapping systems were available and various combinations of refractories could be used for tapping holes when melting with basic slags. Rammed stabilized dolomite was satisfactory for runs of a few-hours duration. For longer operating periods, a graphite/ganister mixture had proved resistant to basic-slag attack. Equal weights of graphite and ganister intimately mixed and rammed into position gave a reasonable life. Magnesite bricks has also been used, but perhaps the most satisfactory material was a rammed carbon proprietary preparation, if precautions were taken to prevent oxidation of the surface at the completion of a melt.

Slag fluidity was important; when the $SaO : SiO_2$ ratio was increased beyond 1.20, the slag viscosity was increased, which could cause some difficulty with front slagging. However, a more generous addition of fluorspar than normal maintained the fluidity and it could be recommended that the calcium fluoride content of the slag be held above 3.0 per cent. It was also helpful to retain a layer of charcoal on the surface of the slag in the front-slagging arrangement and to keep a gas flame playing on to this surface.

MR. A. E. PEACE who spoke in his capacity as chairman of the Technical Council, the body ultimately responsible for the Report which had been presented, said he thought they were all grateful for it and felt pride in the Institute for having attracted so much information from the few firms in this country operating hot-blast cupolas at present. It had for many years been quite reasonable to expect people who were operating a new process to keep their experimental work to themselves and not to divulge information until they had got the project into a satisfactory position. He could tell them that in the sub-committee there had been freedom of contribution from various members, which he thought outstanding and which must be welcome.

Silicon/Carbon Balance

As an ordinary member, he would direct attention to the advantages of hot-blast additional to the quantity of coke saved. These were fully set out in the Report and the list was a comprehensive one. A point of considerable importance was the fact of reduced losses, particularly in these days of unfavourable economic metal costs to the foundry. In that connection he had a question to ask which might be difficult to answer; it was: "To what extent the temperatures inevitable with hot-blast affected the loss of silicon, or the pick-up of silica in relation to the pick-up of carbon?" There seemed to be some mystery about it. Personally he was interested in low carbon, but most people were, he thought, interested in producing high-carbon metal, yet in operating with a hot-blast cupola it was possible to have carbon at 2.6 or 2.7 per cent. quite easily. With cold-blast cupola operation, there was very heavy silicon loss—an element expensive to replace. From actual experience with air furnaces, he knew there was some critical temperature where one got a changeover of preferential oxidation, that is, above certain temperatures one could pick up silicon and tended to lose carbon. Were there any noticeable effects in that respect with hot-blast cupolas?

Another point was dust emission. That had nothing to do with economy or the quality of the metal, but it had a lot to do with their continuing in operation. The day appeared to be getting closer and closer when there would be an extension of smokeless zones and some founders would find themselves hard put to it to eradicate the dust nuisance in neighbourhoods where there was dense housing. One appreciated that the recuperative system would catch much of the cupola emission, but he thought it was mainly the very-large-particle emission, which in all probability would drop on the works anyhow. What was the dust situation at some distance from the works? Was there likely to be there an emission which was a nuisance, and if one had to observe such laws as might come into existence in the future would founders have to instal some dust-suppression plant after a recuperative hot-blast system?

Water Cooling

He thought water cooling had a great advantage in prolonging the time that a cupola could be operated without fear of trouble, and in his own practice on a small installation a cupola was operated for eleven hours a day in order to get enough metal to pour for about 7½ hours a day. It

would be impossible with the existing size of cupola to do this without water cooling. There was a minimum increase in the diameter of the melting zone and after the first two-hours' melt, the furnace was really operating on the water-coolers for the rest of the day. This minimum change in diameter throughout the "blow" made for good control and uniformity of composition.

MR. RENSHAW agreed sufficient evidence was not yet available to give a definite answer to Mr. Peace's question on silicon and carbon pick-up, that is, to state the operating conditions using hot blast, which would reduce silica to silicon and at the same time restrict carbon pick-up. The nearest example the sub-committee could quote was that shown in the case of Plant D melting white-heart malleable iron where hot-blast operations had been responsible for a lowering of the silicon loss along with a small degree of carbon pick-up. It would appear that a high melting-zone-temperature favoured lessened silicon loss and to obtain an actual increase in silicon over that charged necessitated utilizing more liberal quantities of coke, which in turn gave a higher carbon pick-up. Such a requirement as stated by Mr. Peace should be kept in mind in future discussions.

Referring to dust emission, this was obviously reduced with a recuperative system when the coke charge was reduced and the bulk of the top-gas was passing through the system. When operating with higher coke quantities to obtain maximum carbon-pick-up and lessened silicon loss, only a proportion of the stack gas of higher CO content would be utilized for recuperation, the remainder being emitted from the cupola stack.

MR. W. J. DRISCOLL said that it was worth pointing out that in a recuperative hot-blast system the problem of dust suppression must be less difficult than with cold-blast cupolas. First, a substantial proportion of the cupola gas was drawn off and cleaned in the hot-blast equipment, so that there was a much lower volume of dusty gas leaving the cupola. Secondly, the velocity of the remaining gases leaving the cupola was lower so that their tendency to carry grit was reduced. Thirdly, the temperature of the residual gas was lower, so that the problem of cleaning it, should this become necessary, was correspondingly simpler.

MR. RENSHAW thought he might add one further comment on the point of dust emission. In the United States, where air pollution was taken seriously, certain founders operating cupolas with recuperative hot-blast systems had installed electrostatic dust depositors, where the gas was further treated after passing through the recuperator. This was making the cupola a very expensive apparatus.

Acid or Basic?

MR. J. E. O. LITTLE wanted to know if the sub-committee would agree that the lining of the shell, after it had burnt back to say one inch thick should be regarded as neither basic nor acid but, in effect, neutral, in that there would not be any more dissolved away. It was then decided whether the cupola was acid or basic according to the quantity of limestone charged. When putting on basic refractory, was it an advantage to weld strips to the shell to help hold the basic refractory in place? His other point concerned the depth of the melting zone. The changeover from the use of a single row of tuyeres to cupola having balanced blast had given an economy in coke and improved metal temperatures—what was the sub-committee's opinion on single or double rows of tuyeres?

MR. RENSHAW said when employing internal water-jackets, it was agreed that little refractory remained on the surface after a very short period of operation. With the hot-blast/water-cooled arrangement described in the Report and using spray cooling with protruding tuyeres, a limited thickness of refractory remained on the cooled surface. When no further refractory was being absorbed by the slag, it could be assumed that the flux charged could be increased and a more basic slag produced. When applying basic refractory in the region of the melting zone, say, to a height of 6 ft. above the tuyeres, it would be inadvisable to utilize supporting rings which might become exposed. The remainder of the refractory above the melting zone could be supported on an annular cleat.

Regarding the number of rows of tuyeres, in hot blast practice it was general to employ a single row.

MR. LITTLE interposed to say—on the question of lining—that if no basic or acid refractory remained on the shell, it appeared to him as a straightforward case for a neutral lining.

MR. RENSHAW agreed that this was an interesting point, but a suitable neutral lining material would have to be found. Carbon, although an ideal neutral refractory in some ways, suffered oxidation in the melting zone.

Design Factors

MR. F. C. EVANS said as members probably knew there were only about ten hot-blast cupolas working in this country as against about 200 on the Continent. The sub-committee were to be congratulated on the amount of information they had collected.

On the question of blast temperatures, there was no difficulty in designing a plant for temperatures up to 700 or 800 deg. C., but of course it was largely a question of cost. The normal type of plant was developed to give 500 deg. C. and at that temperature ordinary engineering materials, such as mild steel and cast iron could be used for the hot-blast line. Above such temperatures constructional engineers would have to adopt special materials and the cost of plant would rise accordingly. There was one plant on the Continent using a blast temperature of 700 deg. C., but, so far, there had been no report of operating details. However, these seemed to be satisfactory because the same group of manufacturers were now building a second plant. The whole question of hot blast, whether at 500 or 700 deg. C., was largely a question of economics, and he thought the basis for using 700 deg. C. could not be considered until someone published data on it.

MR. J. L. FRANCIS asked if Mr. Renshaw could say whether the advantages of hot blast were similar or not to those which derived from oxygenation of the blast. Secondly, was it necessary to increase the

blast volume in proportion to its temperature over cold blast?

MR. DRISCOLL said he did not think the effects of oxygen enrichment had been established sufficiently clearly yet to say whether they were the same or similar to those of hot blast. He thought it likely that many of the effects were similar, but some of them might well be different. For example, it was quite possible that a cupola working with oxygen enrichment would not give the same advantages from the points of view of higher carbon pick-up and lower silicon loss.

Regarding the increase in volume of air with temperature, the actual volume in terms of cubic feet did, of course, increase with the temperature, but in referring to the air supplied to a hot-blast cupola it was always converted to standard cubic feet of air at normal temperature and pressure, although it was in fact at a higher temperature with a correspondingly higher volume.

MR. RENSHAW added that the sub-committee was planning to include consideration of oxygen enrichment in future work.

The CHAIRMAN, closing the meeting, said members had every reason to be proud of the work of the Technical Council. Mr. Renshaw and the sub-committee deserved their thanks.

[The Chairman's remarks were greeted with applause.]

Acknowledging members' thanks, Mr. Renshaw said that the sub-committee was very conscious of the amount of work that remained and it was hoped to draw more enthusiasts into that work.

Design and Operation of a Modified Cupola*

Discussion of Mr. F. A. Woolley's Paper

The second paper to be presented to session "A" of the annual conference of British Foundrymen was "Design and Operation of a Modified Cupola," by Mr. F. A. Woolley, a member of the Institute. Dr. A. B. Everest (senior vice-president) was in the chair.

After the Paper had been read, the CHAIRMAN, opening the meeting for discussion, said Mr. Woolley had given an interesting and stimulating paper which took him back nearly thirty years, when he had done some research work at the Midland Motor Cylinder Company. Even then, the company were pioneers in cupola practice and used cupola mixtures which seemed unorthodox according to all that was taught at the universities.

MR. E. S. RENSHAW complimented Mr. Woolley on his very enterprising undertaking. It demanded courage to conduct work of this nature on a production plant. On the unit described the electrical equipment was capable of supplying 60 kw. per ton of metal melted. In the example given in Table II and using the equipment as a corrective measure, 30 kwh. were employed giving a metal-temperature increment of 45 deg. C. Could Mr. Woolley give some indication of the results he would anticipate by utilizing the full amount of current available and on a continuous basis? One would expect there would be a possibility of reducing the coke charge and thus offsetting the cost of electric current. In this case the application would be more attractive.

MR. WOOLLEY admitted that he and his colleagues had done some experimental work that was rather outside the scope of the present Paper. He asked members to bear in mind that they had taken a cupola furnace and had attempted to modify it by making the coke and slag contained in the well act as a resistor. They had not attempted to design an electric furnace, that was beyond their means as a production foundry. The conditions in the well, as regards the quantity and level of the slag, were changing all the time, so that it was not possible to give a firm constant for the whole period of application. For instance, at a given voltage setting, the ammeters on the instrument panel might show a reading of 3,000 amps. with the well empty. Then, as the metal level rose, this would go up to 7,000 or even 8,000 amps. He took the number of units per minute that the furnace was taking as the measure of the power application, *i.e.*, for an input of so many units a certain quantity of heat was obtained, and that was the measure of the auxiliary heating applied under the conditions ruling at the time. The figure of 60 units per ton of metal quoted was an attempt to indicate some sort of rating for the equipment, and was obtained by dividing the rated capacity of the transformer, 520 kva., by the melting rate, that is 8 to 9 tons per hour.

Possibility of Automatic Operation

MR. C. H. WILSON said Mr. Woolley had indicated that he had used the electric current intermittently in order to keep up the temperature of the whole, and more or less when the foundryman or the furnaceman thought that it was necessary. Would it not be possible to make the whole arrangement automatic with a thermocouple so that when the temperature went down the current was automatically switched on, and when it went up it was automatically switched off? He also asked what it cost per ton of molten metal to maintain the temperature in this way.

MR. WOOLLEY agreed that it was perhaps possible to make the current-control automatic, but possibly at considerable cost in thermocouples. So far, the management had preferred to rely on the large amount of practical skill and experience available from the furnace and foundry personnel who had accepted the modification readily, and it was of the greatest help to have this ready co-operation. He knew of no thermocouple that would stand up to temperatures of 1,400 deg. C. or higher for more than a short period, and the cost of replacement of rare-metal couples would be considerable.

As regards costs, it was found that the use of the modification as an intermittent booster worked out at between one and two shillings per ton of metal melted. The items used were the electric power and the electrodes. Wear and tear on the electrical gear was practically nil. Occasionally, a bolt on an

* Printed in the JOURNAL, August 5, 1954.

electrode holder burnt out, but the rest of the installation required substantially no maintenance. The only consumable items therefore were the power, and the ends of the electrodes, and this could safely be put at less than 2s. per ton of metal.

Compositional Changes

MR. FLEMING said that towards the conclusion of the Paper, on page 7 of the preprint, a reference was made to the degree to which the composition of the metal was affected, which depended on the quantity of power and the condition in the well at the time of application. As the cupola was tapped intermittently, he presumed that by the term "condition in the well" was meant the depth of metal and the depth of slag. Could Mr. Woolley enlarge on what those effects were on the running of the cupola and the differences he experienced if the slag depth was higher or the metal depth greater?

MR. WOOLLEY pointed out that it was stated in the Paper that the cupola was tapped intermittently, so that the level of the metal and the slag was rising and falling between taps, all the time in the manner he had explained. However, what he had in mind in the case cited, was the quantity of slag in the well, the iron-oxide content of the slag and factors of that nature. He believed the more slag there was in the well and the more iron oxide there was in the slag the more of the energy put in by the electrodes would be absorbed in chemical reaction in reducing FeO in the slag than in actually raising the temperature of the metal. The reactions that took place for the reduction of the FeO and SiO_2 were endothermic and would absorb much energy. The more FeO, the more heat there would be absorbed in its reduction instead of in keeping up the temperature of the metal.

MR. FLEMING said he had wondered if tests had been taken at short intervals during the period when the slag depth was increased. And whether any analytical difference had been noted between just before and just after a tap of slag.

MR. WOOLLEY agreed that such tests had been carried out and a tendency had been found for an increase of carbon and silicon content when the slag depth was low. As the slag increased, so the carbon content tended to go down. It had been found that in ordinary practice the iron oxide content in the slag—which, in their experience ranged from 1½ to 2½ per cent. FeO, absorbed electrical power. However, after a time the FeO was reduced to 0.4 per cent., which was the lowest figure so far attained.

Chill-Test Interpretation

MR. A. E. PEARCE asked was he to infer from the remarks in the last paragraph of page 7 of the preprint, that apart from chemical analysis in control, Mr. Woolley used a chill test? He would like to know what experience had been gained with that, and what was the uniformity of chill test through the run when operating with the electric assistance and when operating the cupola without it. Did its use actually "iron out" some of the variations which were normal in straight, unassisted cupola practice?

Mr. Woolley said one point which should be made quite clear was that the changes in chemical composition were small. From results over a 30-week period, there was evidence that there was a movement in a particular way—that was towards an increase in carbon and silicon. If an individual test was taken at a certain time it might be found silicon had gone up 0.03 or 0.05 per cent., but who was to say that that was an analytical error, or that it would not have gone up in the ordinary working of the furnace? With a furnace operating continuously, one had to take the long view in order to arrive at a conclusion. The composition changes were small and almost within analytical error, but they happened so many times over the whole period, that they could not be ignored.

As regarded the chill test, when the power had been on for 10 or 15 minutes there was a slight reduction in the amount of chilled white iron, found on the test-piece. The reports gave that repeatedly and continuously, but whether it was due to the rising temperature of the metal, or inoculation of another type affecting the type of metal he would not like to say.

MR. J. L. FRANCIS asked if the reduction of ferrous-oxide content of the slag made any appreciable difference to the sulphur content. He thought that reducing the FeO content would give a slag which tended to de-sulphurize and that might have a bearing on the amount of chill recorded.

In that connection, MR. WOOLLEY emphasized that his was a production foundry and opportunities for investigations of that sort were naturally limited. The staff had followed the fall of FeO in the slag with the use of power, but the sulphur might have moved within a certain range, but whether that move was towards a reduction or not he would not like to say. The foundry was not troubled about the sulphur content.

MR. FRANCIS then asked if any trend or tendency towards a decrease had been noted.

MR. WOOLLEY said it was a point that had not as yet been investigated.

MR. HAYNES asked for information as to any difficulties that had been experienced in the initial stages and what metal mixtures had been used.

MR. WOOLLEY, suspecting some misunderstanding, said if anything did happen to go wrong then the auxiliary heating had on occasion proved useful in cases where the furnace would have had to stand. As to the number of mixes, there was only one used, the object being to produce the same material week in, week out, year in, year out.

THE CHAIRMAN, closing the discussion, proposed a vote of thanks which was cordially approved by the members.

Cupola Practice—Second Thoughts*

Discussion of Mr. W. Y. Buchanan's Paper

The final Paper to be presented at session "A" of the annual conference of the Institute of British Foundrymen, in June, was "Cupola Practice—Second Thoughts," by Mr. W. Y. Buchanan. Dr. A. B. Everest (senior vice-president) presided.

* Paper printed in the JOURNAL, September 16.

A MEMBER, opening the discussion, gave it as his opinion that a cupola could be a complicated piece of equipment, if one cared to make it so, or it could be a smooth and simple-working workshop tool. Did he understand correctly that Mr. Buchanan's cupola linings were now rammed, or was he using shaped bricks? Had he tried laying bricks using no cement between the courses?

MR. BUCHANAN replied that the lining was rammed, using ordinary soft cupola patching which was pushed between the cooling-water tubes and smoothed off. The only trouble was that the water had to be kept circulating in the pipes, even whilst using a small fire to dry the lining. The result was that at the higher temperature when melting commenced, a considerable quantity of steam still had to be driven out. This did no harm. The best procedure was to air-dry the lining for as long as possible, in thin consecutive layers. He had, of course, used shaped bricks in the 45-in. balanced-blast cupola without any cement between them. Even when using cement, this was applied with a whitewash brush so as to get the thinnest possible joints. This practice increased the general life of the brickwork.

Dust Emission

MR. HARRISON, referring to Fig. 9, asked if Mr. Buchanan had any water containing fine dust carried out at the top of the cupola stock.

MR. BUCHANAN said he did not think there was very much. If a cupola was operated for hours such a thing might occur. He thought it was a matter of design of the water spray and the quantity of water used.

MR. HARRISON said he thought Mr. Buchanan was very fortunate in having an adequate water supply; if less water was employed, would there be more dust, or a tendency in that direction?

MR. BUCHANAN agreed there would be. Sufficient water was used; it was possible to put one's head over the cupola top when the blast was on. He had changed from recirculating tank water to town's water, but had been mislead by the local water company as to the quantity and pressure of water available. The pressure and quantity delivered got worse and the price rose sharply, so that a small pumping station was built at the edge of the works grounds adjoining a stream. It was a simple matter to arrange a suitable catchment basin and arrange the flow so as to maintain a deep natural pool.

Corrosion Difficulties

MR. HOLLADAY mentioned that his firm was also using a wet-type spark-arrester with success. The plant was recirculating the same water and that had led, as was the case with other founders, to trouble with corrosion due to sulphur dioxide being dissolved in the water. He had reduced the build-up of H_2SO_3 by using a certain amount of the stored water for damping down each night. Then, from the limited water supply available the storage tank was filled up overnight. That procedure seemed to reduce corrosion to manageable proportions and it also enabled the use of a large quantity of water without keeping the water-meter continuously working. The method also saved a certain amount of roof cleaning, but the quantity of water was important in relation to the quantity of fine dust which was collected. A quantity of fine dust with the water spray was deposited on the roof, but it seemed to cause discolouration rather adhering as solid matter.

MR. BUCHANAN said he had at first recirculated the cooling water and had since warned foundrymen against the danger of corrosion. A large percentage of the coke dust and sulphur dioxide was absorbed in the water from the fumes and it was even possible to extract the blue smoke which came from grease, and grease could be observed floating on the water. Sulphur dioxide and small particles of coke dust which would not settle out kept on going round and round very rapidly in any recirculatory system. This gave accelerated corrosion and erosion. If one diluted the recirculating water, that must naturally improve matters, but it was a case of every foundry dealing with its own set of conditions. The more fresh water used, the better it worked. The B.C.I.R.A. had found a reduction of as much as 50 per cent. in the sulphur-dioxide content of fumes emitted. That might represent a very important improvement in a heavily-built-up area.

MR. LUNT asked if there was any indication as to the quantity of water necessary for a wet spark arrester.

MR. BUCHANAN replied that on a cupola of 45-in. bore about 3,000 gallons per hr. was required. That did not, however, quite answer the question. It depended on how the water was used. If the water was allowed to fall in a heavy sheet it was very insufficient even if a very large quantity was used. A fine spray was much better, but this required pressure and a restricted nozzle.

If a centrifugal pump was used to lift the water, say, 40 ft., and this was near the limit of the performance of the pump, the water delivered would have very little pressure. This could be rectified by using two-stage pumping.

Sprayed Refractory

MR. H. HAYNES said he would like to know the thickness of refractory sprayed on and the quantity of water used in the spray and how long a time elapsed before the job had to be done again. He was particularly interested, because the railway companies seemed to be employing sprays for a great variety of purposes.

MR. BUCHANAN, referring to the question of how to apply the ganister by spray, said he was afraid he was no authority on the subject. There was a quantity of information available in America, where the system had worked very well apparently.

In the paper he had quoted an American example where they had actually cleaned a furnace down, patched it by that method, made up the bottom, got the first charge heated and tapped the

(*Continued on page* 362)

Electric-induction Furnace on Industrial Frequency for the Production of Cast Irons*

[SLIGHTLY ABRIDGED]

By Aldo Tagliaferri and Claude Barbazanges

More than 30 induction furnaces with magnetic cores are at present in use in Italy in foundries making cast iron. Some are used as forehearths, but in most cases they have supplanted the cupola itself and are used directly for melting. This account details the reasons which have led to the adoption of such units, constructional and operational features and comparative cost data.

Introduction

The difficulty of obtaining high quality cast iron from the cupola is well known. Obviously, there is a possibiiity of producing from the cupola a consistent grade of iron at a suitable temperature, providing that there is a well-equipped laboratory for controlling the iron obtained, as well as reliable raw materials and first-class workmen. This, however, necessitates using only new pig-iron and domestic scrap and the supply of a coke of constant quality. Difficulties in securing consistent material redouble with variations of melting speed which are inevitable with fluctuation in the demand for metal. If the cupola is well regulated so as to give a constant rate of melting it is practically impossible, in spite of the increased consumption of coke, to obtain the same composition and the same temperature at half or three-quarter rate. It is equally impossible, except in the large production foundries with several cupolas in service, to get casts of different composition perfectly conforming to the specification for the castings to be made. The foundry manager is thus obliged to choose an average quality, which may increase the number of rejects and difficulties in machining others. Finally, it may be added, all the difficulties stressed are still much more marked if it is a matter of obtaining metal with relatively low carbon content. For all these reasons, founders have always sought, when they wish to produce casts of high-duty iron, to discard the cupola or at least to furnish it with a heated forehearth thereby permitting of the raising of the temperature and also making possible the necessary compositional corrections.

Amongst numerous types of furnace likely to be developed for these specialized melting applications, the induction furnace on industrial frequency—that is, the induction furnace with a magnetic core—is amongst the most attractive since the heat is produced in the very heart of the metal being melted. The production efficiency of such a unit is particularly high, operation is easy and cost of installation relatively low. This type of furnace has been widely used for a very long time for the melting of alloys of copper and in particular for brass. Its use for the production of light alloys and iron castings is more recent, but at the present time the difficulties encountered by the first users, who had to adapt furnaces built for brass, are completely solved, due to a judicious layout of heating channels and the use of appropriate refractories.

* Paper presented to the Paris International Foundry Congress.

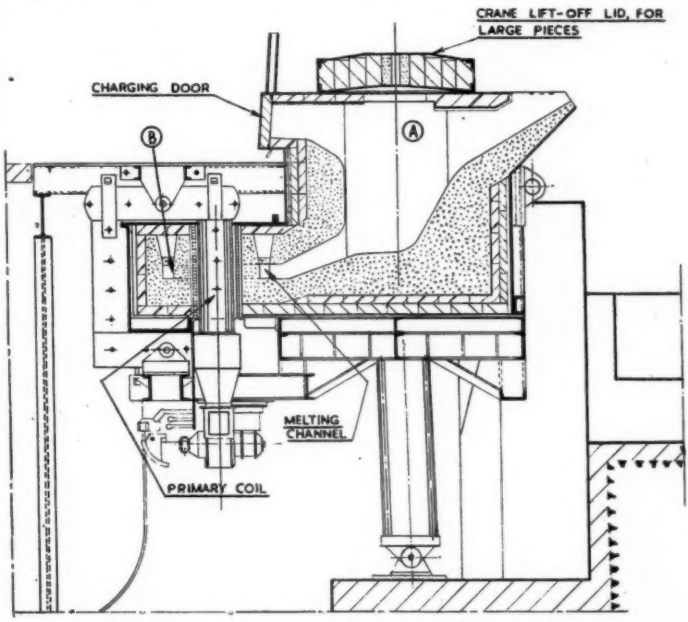


FIG. 1.—*Sectional diagram of a two-phase, industrial-frequency electric furnace for melting iron.*

Electric-induction Furnace on Industrial Frequency

Furnace for Iron Melting

A section of a two-phase furnace of 3 to 4 tons capacity rated at 400 kva. and designed for the production of irons is shown in Fig. 1. As the principle of the induction furnace with a magnetic core, made up of a crucible (A) and circular melting channels (B) forming the secondary of the heating transformer, is universally known, elaborate description is unnecessary. There is, however, need to stipulate that for the production of the melt the secondary channels (B), should be practically horizontal, a fact which moreover gives the advantage of making them accessible.

Electric Equipment

The coils placed around the furnace which make the primary circuit of the heating transformer should be designed generously and carefully insulated. They are air-cooled, the air being provided by fans built on to the furnace and are furnished with warning and safety devices necessary in case of failure. In certain cases, a water-jacket can be fitted around the refractory cylinder which surrounds each coil.

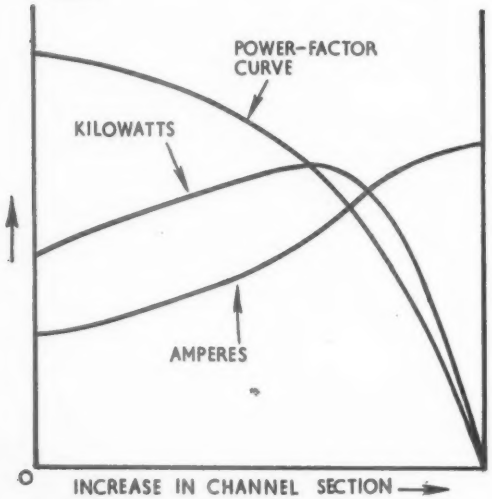
The power developed is a function of the voltage applied to the coil. To allow regulation and to give to the furnace the desirable flexibility of working, the coil is fed by a transformer or an auto-transformer which has a number of tappings sufficient to supply all the requirements of the metallurgical operations. In general, the power can be regulated from 5 to 100 per cent. of its nominal value. In addition, the coil itself has a certain number of regulating tappings which allow the maintaining of correct coupling between the coil and the melting channel during the whole campaign of the furnace, in spite of the wear and tear of the lining. Furnaces of low capacity are always single phase. The feeder transformer (or auto-transformer) is, in general, wired up to the grid, especially when the foundry has a battery of several furnaces.

When local conditions of electricity supply do not allow unbalanced loads, it is possible to improve matters by fitting a 3/1 phase transformer. The larger furnaces are two- or three-phase units and need two or three inductors similar to that shown in Fig. 1. The coupling to the supply of a two-phase furnace is accomplished with a Scott-connected transformer, so as to balance almost perfectly the load on the three phases. The supply to the transformer can be at low or high voltage. In the second case, which is in general that of the high-power furnace, it is necessary to instal a transformer control cubicle, with the necessary protection gear. It should be noted, too, that the electrical demand of the induction furnace is free from surges and therefore causes no disturbance to the supply lines.

Power Factor

The power factor obtained with furnaces for melting cast iron is higher than that for light alloys and lies between 0.7 and 0.8. Many users bring it up to 0.85 or 0.9 by inserting static condensers fixed on the low-tension side, between transformer and the furnace coils. Fig. 2 shows the shape of the characteristic curve for a low-frequency furnace; current and power absorbed, power factor as a function of the resistance of the secondary circuit, *i.e.*, of the section of the melting channel. The furnace should be arranged to work as near as possible at maximum power for the whole of the working period, taking into account the wear of the refractory linings. It is possible, after a certain number of working weeks, to bring the power factor and wattage used to their maximum value by varying the number of turns of the inductor coil. For example, the curve in Fig. 3 shows the variation of the power-factor during a four-month working period, this was taken from a 5-ton furnace used for the production of high-duty cast iron.

FIG. 2.—*Power-factor, power and current according to channel section for a low-frequency electric furnace.*



Mechanical Construction

The low-frequency furnaces used for melting cast iron are of the tilting type. For small capacity furnaces, tilting can be accomplished about the centre of gravity by hand-operated gearing or by electric motor, two such furnaces being shown in Fig. 4.

For larger furnaces lip-axis pouring is usually preferred and control can be made mechanically or rendered more flexible and economical by hydraulic rams. It is deemed wise to make the refractory-lined core and melting ducts (which are the active part of the furnace) independent of the tipping of the chassis. An example of this method of construction is shown by Figs. 5 and 6. This arrangement allows a much more robust construction, which reduces the risk of deformation of the core and thereby greatly increases the life of the refractory

lining. This design also has the considerable advantage of raising the operational period of the plant. By having a spare core without tipping system or electric equipment, it is possible to save, over a furnace working period, the time for breaking out the worn lining and repairing and drying a new lining—which may take 10 to 12 days. The core changing is a simple operation, which can be done in a few hours so that 24 hours after stopping, the furnace is once more ready to pour. For the price of a core—say, about 10 per cent. of the price of a complete furnace—the user ensures continuous production, with no need for a spare furnace.

The capacity of core-type induction furnaces for the melting of cast iron which are actually on the market, varies from 5 cwt. to 8 tons, with ratings from 50 to 800 kva. The corresponding hourly productions are: With cold charge, 130 to 3,000 lb. and, when used with liquid charge, 150 to 10,000 lb.

Refractory Lining

The refractory lining of the furnaces is rammed *in situ*, cold. The material selected should resist the temperature and physical and chemical action of cast iron; it should have very little shrinkage and yet good resistance to thermal shock, to avoid all spalling, where the metal might penetrate. Finally, the lining should become fritted in sufficient thickness at a lower temperature than that of the melting of iron. A careful choice of constituents and grain size and correct method of preparation of the material before use, make it possible to provide refractories which fulfil perfectly all these conditions.

For cast iron, the lining used can be siliceous. The average " life " (taken from actual plants) varies from 3 to 6 or even 8 months, depending on the quality, temperature of the cast, and the detail working of the furnace. Some users prefer to repair the linings before they are worn out, and so to keep up their power factor. Figures were taken in an Italian foundry during a working period of six months, during which 850 tons of cast iron were produced. The user thought it economical to replace the lining after 171 days working and before the complete failure of the lining—an event which might not have occurred for some time.

The melting channels are the most delicate part of the furnace, because of the higher operating temperature and the stirring of the metal there by electro dynamic forces. The quality of this part of the lining can therefore be improved by making it with special refractory material having a high alumina content.

Furnace Operations

Preheating

The ramming of the refractory for the channels is carried out around cast-iron templates which are left in place. For the crucible, sheet-iron templates are used which can be removed before drying. Drying is effected by heat developed in a cast-iron core by applying a reduced power to the furnace. This operation, which is very important for the ultimate life of the refractory, should be carried out with care, and 12 days or so should be allowed for the ramming and drying.

When the drying is finished and it is required to bring the body into service, the rate of heating is slowly increased until the cast-iron core becomes pasty. At this stage, sufficient metal is added to fill the channel by progressively introducing pieces of cast iron. Thus a correct " firing " of the refractory lining of the channels is ensured. The same operation is then carried out for the crucible, and the furnace is then ready to receive its first charge.

Working the Furnace

When on continuous working, it is best always to leave in the furnace a minimum quantity of cast iron sufficient to keep full the melting channel—an amount equivalent to 25 to 30 per cent. of the total capacity of the furnace. This priming of the furnace helps the melting of the added solid iron.

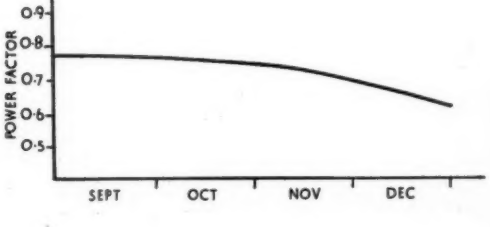
Charging is effected by starting off with light scrap, such as cast-iron borings and steel turnings. Next, pig-iron and heavier scrap are added. It is best to charge the larger pieces after they have been preheated on the slag and to maintain a definite interval of time between two such additions. This avoids the formation of a " pasty " mass and the accumulation of gas under pressure at the bottom of the crucible.

Finally, the finishing materials, such as ferro-phosphorus, ferro-manganese, copper, chromium, nickel, molybdenum, etc., are added.

When it is necessary to recarburize, it is best to do this when the bath is at a low temperature. Indeed, the carburization of a bath at high temperature is difficult and causes a fairly violent reaction. The operation should only be carried out by adding relatively small quantities at such times when a rapid analysis check on the iron shows carbon content lower than that anticipated. Silicon additions are made once the carburization is finished. In certain cases to get a pearlitic structure without separation of ferrite, this element is added in the ladle by the addition of ferro-silicon or of calcium silicide, which has the property of giving a better form and distribution of the graphite.

It will be realized that it is possible to charge the induction furnace with large pieces of metal, of sizes nearly as big as the crucible, without having to put them through pig-iron breakers. In the

FIG. 3.—*Power-factor variation over a four-month campaign for a 5-ton induction furnace melting high-duty cast iron.*



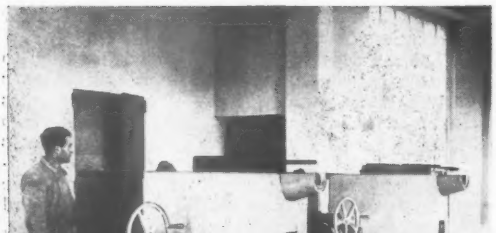


FIG. 4.—*Two low-frequency electric furnaces for melting cast iron and arranged for hand tilting.*

same way, ladles, "skulls" over metal, etc., can immediately be put back into the furnace without pre-casting into ingots—an advantage over cupola practice. The percentage of turnings incorporated in the melt can reach 30 per cent. without any appreciable lowering of production.

In an induction furnace, due to the basic method of heating, the slag is at a lower temperature than the metal and it is necessary to keep it fluid to allow the gas to get away satisfactorily. A good practice is to work under charcoal which protects the iron from oxidation. It is not proposed to enlarge on starting with a liquid charge, as the previous remarks about making the additions equally apply. As will be seen later, the charge melts without change of chemical composition, thus greatly reducing laboratory control. Moreover, the yield from additions and alloys is of the order of 100 per cent. For a normal charge the loss through oxidation is less than 2 per cent.

Furnace Idling Time

During the periods when the foundry is not in operation, it is usual to leave the furnace on a low power tapping and with a minimum of metal filling the inductor slots. The power consumption is about 1/5 of full load. Alternatively, it has been found possible to switch off the furnace during overnight and weekend shut-down periods, leaving a very small quantity of metal in the sump. For long periods of shut-down, it is advisable to empty the furnace completely. To restart, it is necessary to reheat the slot and lining and charge with molten metal or to gain access to the inductor slots and fit a prefabricated starting ring.

Quality of Iron Obtained

The noteworthy properties of the iron produced in the induction furnaces are due to the condition of its production. The heat needed for melting and superheating of the iron is generated in the heart of the metal itself. There is, therefore, neither oxidation of drops of iron by blast, contamination by heating gases, nor local superheating. Moreover, the area of liquid metal in contact with air is reduced to a minimum, and this contact occurs through the slag, exactly at the place where the temperature of the metal in the furnace is lowest. Additionally, the stirring caused by electro-dynamic forces helps the escape of gas and gives to the metal a particularly fine, even structure.

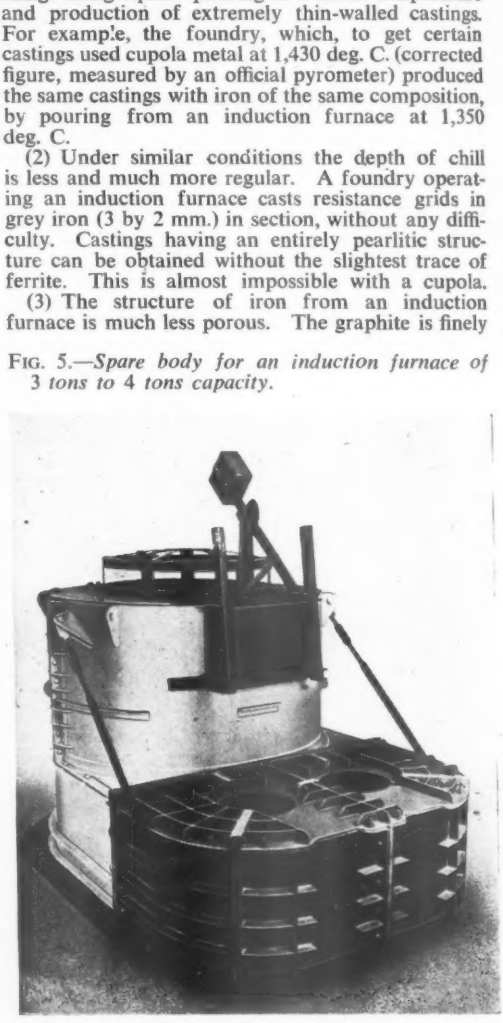
Thus there exist all the conditions for obtaining a sound cast iron, properly deoxidized and well de-gassed so that the founder will have a high-quality metal. The following are points of superiority of induction-melted iron over that produced by orthodox methods:

(1) The "life" is better, and this allows—other things being equal—pouring at a lower temperature and production of extremely thin-walled castings. For example, the foundry, which, to get certain castings used cupola metal at 1,430 deg. C. (corrected figure, measured by an official pyrometer) produced the same castings with iron of the same composition, by pouring from an induction furnace at 1,350 deg. C.

(2) Under similar conditions the depth of chill is less and much more regular. A foundry operating an induction furnace casts resistance grids in grey iron (3 by 2 mm.) in section, without any difficulty. Castings having an entirely pearlitic structure can be obtained without the slightest trace of ferrite. This is almost impossible with a cupola.

(3) The structure of iron from an induction furnace is much less porous. The graphite is finely

FIG. 5.—*Spare body for an induction furnace of 3 tons to 4 tons capacity.*



divided and homogeneous, the carbon content is lower, whilst machining qualities are improved.

The mechanical properties of the iron are clearly improved when it has been made by the induction-furnace process and Table I shows the effect on these properties of the length of time the metal remained in the furnace.

(4) Finally, a great advantage for the user is the fact that the iron undergoes very little change in composition, even if the time in the furnace is lengthened. The necessary corrective additions are very easily carried out and the properties of the iron produced are remarkably constant.

Forehearth and Duplexing

When it is used as a forehearth, the induction furnace acts as an element of control and reduces compositional variations of the cupola product, chiefly due to the influence of different qualities of coke. Italian foundry experiments have shown that variations recorded for the entire melt production do not exceed:—

Carbon	±0.03 per cent.
Silicon	±0.03 per cent.
Chromium	0.04 per cent.
Tensile Strength ..	1.6 ton per sq. in.
Brinell Hardness	7.5 points.

Similarly, during the production of cylinder linings by duplexing (cupola/induction furnace) the most divergent figures observed were (per cent.):—C 2.86 and 3.04 per cent.; S 1.88 and 1.99; Mn 0.96 and 1.06; P 0.98 and 1.06; Cr 0.64 and 0.80. Equally interesting are the variations of mechanical properties of samples taken from different points of the same castings, which are much lower than with iron from the cupola.

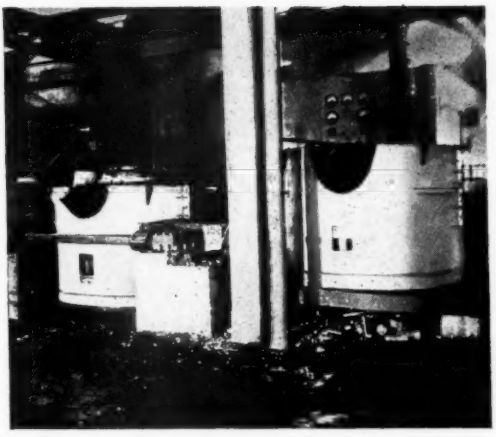


FIG. 6.—*Core-type induction furnace, 2 to 3 tons capacity, in an iron foundry. Note (r.h.s.) the spare re-lined body. After drying, the change of body can be effected in 4 hours.*

Applications and Costs

Below are some examples of the most usual castings made with the induction furnace in Italy: thin castings in grey iron; parts of typewriters; resistance grids for electric motor starters; malleable

TABLE I.—*Effect of Holding Time in the Furnace on Mechanical Properties.*

Length of time in furnace (minutes).	Composition (per cent.)					Transverse strength tons per sq. in.	Tensile strength tons per sq. in.	Brinell Hardness.
	C	Si	Mn	P	S			
2	3.51	1.12	0.47	0.36	0.13	23	13.5	198
45	3.57	1.12	0.47	0.35	0.158	25	15	205
100	3.54	1.02	0.44	0.350	0.120	27.6	16	213

TABLE II.—*Results of a Year's Working in a Foundry having two Induction Furnaces.*

Year	1949.		1950.		1951.		1952.	
	Cupola.	Electric Furnace.	Cupola.	Electric Furnace.	Cupola.	Electric Furnace.	Cupola.	Electric Furnace.
Charge in tons								
Solid	—	2,836	717	2,810	2,321	1,874	5,163	1,705
Liquid Iron	—	—	—	717	—	2,321	—	5,163
Total	—	2,836	717	3,527	2,321	4,195	5,163	6,866
Cost per ton charged in £'s*								
Electrical Energy	—	2.05	—	2.05	—	2.72	—	2.95
Charcoal	—	0.26	—	0.27	0.05	0.27	0.17	0.21
Refractories	—	0.67	—	0.78	0.87	0.53	0.82	0.34
Coke	—	—	—	—	2.1	—	2.1	—
Limestone	—	—	—	—	0.05	—	0.07	—
Total	—	2.98	—	3.10	3.52	3.52	3.16	3.50
Temperature of pouring (deg. C.)	—	1,290–1,300	—	1,330–1,340	1,250	1,330–1340,	1,250	1,380–1,430

* Sterling prices obtained by converting L(IT) at standard rate of exchange of 1,740 lire = £1. The total cost per kg. includes the cost of melting the solid charge and the cost of superheating the liquid iron coming from the cupolas at 1,250 deg. C. to 1,380 to 1,430 deg. C. In 1952, the costs for the refractories were fairly high and were due to a part of a refractory of low quality used in February which quickly put three linings out of action.

N.B.—With the induction furnace all pigged iron (cold iron) arising from the first cast of the cupola has been eliminated. If the iron is superheated in the electric furnace it is possible to use even the first liquid metal, although its initial temperature be low. This could not be done without the electric furnace. The consumption and cost of production have been kept within the limits given in Table II, as the iron was poured at a low temperature (about 1,250 deg. C.).

Electric-induction Furnace on Industrial Frequency

iron; spheroidal graphite iron; various castings for automobiles—cylinder jackets, blocks, heads, etc.

A comparison showing the cost of iron from the cupola and from the electric furnace working from solid charges and when duplex working has been made from the results of work at a foundry with two 28-in. dia. cupolas (on alternate days working) and two electric furnaces of which the characteristics are shown in Table II. In this are shown the annual productions and a breakdown of average costs for 1949-52. It should be noted that during two consecutive years, production relied entirely upon the induction furnaces working with cold charges and that under the local economic conditions, the cost price of the iron was lower than that from the cupola.

From 1950, the increase of the foundry output (the programme went progressively from 3,000 to 8,000 tons per annum) and the lack of electric power for the extra induction furnaces which would have been necessary, resulted in the installation of a cupola and duplex working. The high quality of the iron produced can be associated with this development.

At the present time, the foundry is working two shifts, the induction furnaces being kept "idling" during the night shift and the weekend stoppage. The monthly production is about 400 tons of good castings, which means 700 tons of metal in the ladle, of which more than 80 per cent. is made by duplexing, the remainder being obtained from the induction furnaces, from cold charges. The iron from this cupola is of composition C = 3.5; Si = 2.4; Mn = 0.3; S = 0.050; P = 0.050 per cent. Starting with this iron two types of casting irons are made, one in electric furnace No. 1 (by adding steel) and the other in furnace No. 2, the former giving C = 3.3; Si = 2.0; and the latter C = 3.5; Si = 2.4 per cent. The iron is produced under a charcoal slag, and the silicon is adjusted for each cast by a ladle addition of granular ferro-silicon (75 per cent.). Special melts are produced after the cupola shifts are ended, and usually from cold charges, so as not to upset current production. Fig. 7 shows a typical three-phase furnace for melting refining of cast-iron alloys. The working characteristics of low-frequency furnaces are as follow:—

Useful capacity...2 tons 6 cwt.	Consumption when duplexing:
Transformer, 3/2 phase ... 400 kva.	continuous working ... 95 kwh per ton.
Condensers ... two of 70 kva rating.	annual average ... 150 kwh per ton.
Melting rate with cold charge ... 10 cwt. per hr.	Complete lining ..... 6 tons.
Duplexing rate ... 2 tons 5 cwt. per hr.	Average lining "life" ... 4 to 6 months.
Casting temperature ... 1,300 to 1,350 deg. C.	Consumption of rammed refractory: cold charges...31 lb. per ton. duplexing ... 7.7 lb. per ton.
Power used at full charge ... 310 kw.	Refractory and insulating bricks: cold charges ... 1.5 lb. per ton. duplexing ... 0.5 lb. per ton.
Consumption with solid charges: continuous working ... 440 kwh per ton. annual average (inc. reheating ... 690 kwh per ton	

It should be noted that these working conditions are far from being the most favourable for induction furnaces. It would be possible by operating the duplex process fully, to reduce the corresponding consumption for continuous working from 96 to 60 or 70 kwh. per ton. Furthermore, a three-shift system would greatly reduce the overall kwh. by eliminating the idling period.

Other Cost Comparisons

The following prices are based on industrial results obtained in the foundry mentioned to give average conditions. Table III gives a comparison of costs for cast iron based on economic conditions obtaining in March, 1953, given the three following conditions: (*a*) Production by cupola only; (*b*) production by low-frequency furnace from cold charges, and (*c*) production by l.-f. furnace working in duplex with a cupola.

Provided that there is available high-tension current, at a reasonable price, and the opportunity of using an induction furnace to produce high-quality iron, starting from raw materials of lower quality than those needed by the cupola (using, may be, a proportion of borings or turnings), the

FIG. 7.—*Typical three-phase, low-frequency furnace for melting and refining cast-iron alloys.*

difference in costs between the cupola and the induction furnace using cold charges is relatively slight and does not exceed 20s. to 30s. per ton produced.

When the l.-f. plant is used as a receiver, the working costs of the induction furnace do not exceed 30s. to 40s. per ton. One can thus achieve a cost for cast iron similar to that of the cupola alone. To obtain this latter result, it is necessary to instal two cupolas (one in reserve), and two induction furnaces of appropriate capacity. To reduce the primary costs of the electrical installation, one could be content with a single transformer, followed by a regulating auto-transformer for each furnace. This transformer could be set to cope with the working of one furnace on cold charges or two furnaces on liquid-metal charge. Such an installation would have these advantages:—

(*a*) Superior quality of iron, with all the saving of scrap and costs of machining. This is true, no matter how skilled the melter at the cupola and the control precautions taken.

(*b*) Flexibility of working and the possibility of making mixed types of castings if the need arises.

(*c*) Ease of working and use; exclusion of pigging of cold metal, excessive skulling of ladles, etc.

Reference has been made to the development of this type of furnace in Italian metallurgy, the technique of which is the basis of this study. A similar effort has been made in the same direction in Germany and countries like Great Britain and the U.S.A. seem desirous of entering the same field. It can be added that certain French users are at present showing interest in this process. The first results obtained show that the induction furnace on industrial frequency has a distinct future in French foundries making high-quality cast-iron.

TABLE III.—*Comparison of Costs for Cupola Melting, Low-frequency Melting and Cupola/L.-f. Electric Duplexing based on March, 1953, Conditions.*

	Unit price.	Cupola.			Induction fce., 400 kva. 3/2 phase.			Duplexing. Cupola.			Elect. fce.		
		Quantity.	Per fce. ton.	Totals per fce. ton.	Quantity.	Per fce. ton.	Totals per fce. ton.	Quantity.	Per fce. ton.	Totals per fce. ton.	Quantity.	Per fce. ton.	Totals per fce. ton.
	£ s. d.	Cwt. Q. Lb.	£ s. d.	£ s. d.	Cwt. Q. Lb.	£ s. d.	£ s. d.	Cwt. Q. Lb.	£ s. d.	£ s. d.	Cwt. Q. Lb.	£ s. d.	£ s. d.
Metallic Constituents:													
Pig-iron, hematite quality ..	4 18 10	7 1 17	5 10 7	—	—	—	—	7 1 17	5 6 4	—	—	—	—
Ordinary	14 7 4	—	—	—	5 1 5	3 16 1	—	—	—	—	18 1 17	13 9 8	—
Liquid cupola metal ..	14 13 1	—	—	—	—	—	—	4 0 0	1 12 2	—	—	—	—
Scrap	8 0 11	4 0 0	1 12 2	—	4 0 0	1 12 2	—	8 0 0	4 12 0	—	—	—	—
Returned foundry scrap	11 9 11	8 0 0	4 12 0	—	8 0 0	4 12 0	—	—	—	—	2 0 0	0 8 7	—
Turnings	4 6 2	—	—	—	2 0 0	0 8 7	—	—	—	—	—	—	—
Ferro-silicon (10 per cent.)	15 10 4	2 0 0	1 11 0	—	1 0 0	0 15 6	—	2 0 0	1 11 0	—	—	—	—
Ferro-Mn (80 per cent.) ..	36 15 8	0 0 22	0 7 3	—	0 0 11	0 3 8	—	0 0 22	0 7 3	—	—	—	—
	—	1 t. 1 cwt. 2 q. 11 lb.	£13 13 0	£13 13 0	1 t. 0 cwt. 1 q. 16 lb.	£11 8 0	£11 8 0	1 t. 1 cwt. 2 q. 11 lb.	£13 8 9	£13 8 9	1 t. 0 cwt. 1 q. 17 lb.	£13 18 3	£13 18 3
Non-metallic Constituents:													
Coke (lighting incl.) ..	4 7 4	2 3 6	0 12 3	—	—	—	—	2 3 6	0 12 3	—	—	—	—
Charcoal	86 4 2	—	—	—	0 — 13	0 10 0	—	2 3 6	0 12 3	—	0 — 7	0 5 5	—
Limestone	0 17 3	0 3 6	0 0 8	—	—	—	—	0 3 6	0 0 8	—	—	—	—
	—	—	0 12 11	0 12 11	—	0 10 0	0 10 0	—	0 12 11	0 12 11	—	0 5 5	0 5 5
Cost of Production:													
K.w.h. fce. (high tension) ..	0 0 0½	—	—	—	500 lb.	1 11 3	—	—	—	—	150 lb.	0 9 5	—
Auxiliaries (low tension) ..	0 0 1¼	10 lb.	0 1 0½	—	10 lb.	0 1 0½	—	10 lb.	0 1 0½	—	3 lb.	0 0 4	—
Labour	0 3 6	1.5 hr.	0 5 3	—	1.5 hr.	0 5 3	—	1.5 hr.	0 5 3	—	0.4 hr.	0 1 4½	—
	—	—	0 6 3½	0 6 3½	—	—	1 17 0½	—	0 6 3½	0 6 3½	—	0 11 1½	0 11 1½
Maintenance:													
Special refractory elect. furnace	45 19 6	—	—	—	0 0 22	0 9 0	—	—	—	—	0 0 4	0 1 8	—
Cupola	5 14 11	0 1 5	0 1 8	—	—	—	—	0 1 5	0 1 8	—	—	—	—
Refractories	14 7 4	0 0 6	0 0 4	—	0 0 1½	0 0 2	—	0 0 4	0 0 6	—	0 0 0½	0 0 1	—
Maintenance labour ..	0 3 6	0.5 hr.	0 1 9	—	1 hr.	0 3 6	—	0.5 hr.	0 1 9	—	0.25 hr.	0 0 10½	—
	—	0 3 11	0 3 11	0 3 11	—	0 12 8	0 12 8	—	0 3 11	0 3 11	—	0 2 7½	0 2 7½
			14 16 1½			14 8 2½			14 11 10½			14 17 5	

Cupola Practice—Second Thoughts

(*Continued from page* 354)

metal in 45 minutes, or something like that. He had been told it had been done by having a number of large metal buckets in which the coke was already heated to incandescence and then dumped into the cupola.

In using the spray, the thickness applied did not matter. In fact, if there was a hole or cavity four inches deep it could be filled quite easily. If one held the gun in one position, one could build up quite a hillock. There was something in it but it was only worthwhile installing that sort of equipment in limited cases. In its present form the operation of the spray gun occupied three men.

Balanced-Blast Features

MR. GRANT said that when he saw the title of the Paper, and the reference to the 1935 Paper on the balanced-blast cupola, he had wondered if Mr. Buchanan was going to explain why, on second thoughts, he had rejected the balanced-blast principle. He was agreeably surprised that that was not so, and, in fact, that the auxiliary tuyeres had been kept open, even the main screw valves were free to rotate.

He had seen many balanced-blast cupolas which had had the auxiliary tuyeres blanked off, the screw valves had "seized," and the cupola was just operating as an ordinary cupola, though with a small tuyere area. The success of the balanced-blast cupola had been mainly due to the fact that it was a well-designed cupola. It had an adequate zone between the tuyeres and charging door for preheating the descending charge, a small tuyere area, and as a new and expensive installation, it was always insisted that charges were weighed, and the cupola was operated efficiently.

He wondered if Mr. Buchanan had any further thoughts on the balanced-blast principle, because in his earlier paper he had written very favourably about it. Could he say, for instance, what advantages a cupola with auxiliary tuyeres gave over one without them?

MR. BUCHANAN said he had nothing to do with the designing of the furnace at all. It was installed and started up by Mr. Bolton. The only thing he would say was that he had come to the conclusion that it was a good furnace, and since then he had not seen any reason to change anything about it.

The session was concluded with a vote of thanks proposed by the Chairman.

Patternmakers' 4s. Award.—Patternmakers working in engineering shops are to receive an immediate increase of 4s. a week in their differential rate under the terms of an award by the Industrial Disputes Tribunal (No. 596). Patternmakers employed on time work, receive a differential of 4s. 8½d. over the skilled fitters' minimum basic time rate of 144s. 10d. per week. They also receive a supplement of 12s. 9½d. per week, the effect of which is to bring their weekly wage into line with that of patternmakers paid by results.

Publications Received

The British Iron and Steel Research Association. Annual Report for 1953.

This book, which runs to about 150 pages, records how £467,000 was spent, and it makes interesting reading. For instance, we are told "cast iron corroded less rapidly than unalloyed low carbon steel in the atmosphere, but at about the same rate when immersed in sea water. Some graphitization occurred in cast iron under the latter condition. It proved impossible to correlate the results of accelerated laboratory tests with those of outdoor exposures. Tests in the B.I.S.R.A. rotor apparatus on nodular cast iron have shown that in both distilled water and sea water some specimens are liable to severe graphitization and erosion." The Report is nicely illustrated, and carries pictures of the opening of the new buildings in Sheffield.

The African Native Market in the Federation of Rhodesia and Nyasaland. Prepared by the United Kingdom Trade Commissioner, Salisbury, and published by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2. Price 1s. 6d. net.

It is obvious from a perusal of this very interesting report that there are two distinct markets to cater for in the Federation—the urban market, where the tendency of the native is to emulate—with a few exceptions—the European, and the native reserves, where the traditional "Kaffir truck" still persists. The tables of imports are especially interesting to the foundry industry because, enamelware and hollow-ware; stoves; ranges and parts; bicycles, tricycles and parts; sewing machines; gramophones and musical instruments are, after textiles of course, the chief imports. A factor of increasing interest is that of advertising, and some illuminating information is given. As this is an ever increasing market, this report should be studied by all firms supplying the Federation.

Servizi e Assistenza Sociale di Fabbrica (Works Social and Provident Services.) Issued by Ing. C. Olivetti and Company, Limited, Ivrea, Italy.

It takes over 120 pages in this brochure, to list, describe and illustrate the various social services undertaken by this well-known firm of typewriter manufacturers. Rightly, the first to be listed is that of maternity and infant welfare, where clinics, rest homes, nurseries and kindergarten have been established. Under the heading of "Youth," there is a school attached to the works, which is divided into three sections, one for a proper apprenticeship course, a second for maintenance mechanics, and the third a technical institute.

The works services include the provision of transport and the repair of bicycles and motor scooters. The next section is housing and its finance; then comes the library, adult education and facilities for sport. An important service provided is that for promoting health and hygiene and in this connection there is a works infirmary and a sanitorium. The final section relates to the provident association, which covers family allowances, pensions, insurance, and so forth.

The book is splendidly illustrated by a number of artistic pictures.

Now you know! ". . . and in case you do not know what a blooming mill is, it converts brittle cast iron into softer stuff which can be bent and shaped. . . ." Extract from the daily Press.

Personal

Mr. J. G. McLeod has been appointed works manager of the Willesden factory of Bowden (Engineers), Limited, London, N.W.10.

Mr. G. G. Buckingham has been appointed manager of the Manchester office of Babcock & Wilcox, Limited. He succeeds the late Mr. F. W. Woodfield.

Mr. C. G. Tangye, M.I.Mech.E., has been elected chairman of council of the British Internal Combustion Engine Research Association in succession to Mr. H. Norman G. Allen.

The Council of the Institute of Metals has elected Mr. H. S. Tasker a Fellow, in recognition of his distinguished services to the Institute. The number of Fellows is limited to twelve.

Richard Thomas & Baldwins, Limited, announces that Mr. W. F. Gilbertson has been appointed deputy general manager and works superintendent of Ebbw Vale Works, and has taken up his duties.

Mr. H. Laithwaite has been appointed managing director of Metal Porcelains, a subsidiary of Incandescent Heat, Limited. He has been with the Radiation group since 1935, where he was in charge of vitreous-enamel manufacture.

The Ministry of Fuel and Power announces that the Minister has reconstituted and strengthened the Fuel Efficiency Advisory Committee by the appointment of three additional members, Dr. G. E. Foxwell, Mr. B. E. A. Vigers, and Dr. W. A. Macfarlane.

Mr. R. E. Rutherford, technical service engineer of Bryce Berger, Limited, manufacturers of fuel-injection and starting equipment, of Staines (Middx), left recently on a four months' tour of India and the Far East, which will include visits to Malaya, India, Ceylon, Thailand, Hongkong, Burma, and Pakistan.

Sir Archibald Forbes has been elected a member of the Board of "Shell" Transport and Trading Company, Limited. Sir Archibald is chairman of the Iron and Steel Board and a director of Spillers. He was president of the Federation of British Industries for two years until his retirement from that office in April last year.

Sir William Scott, who is to act as representative of the Federation of British Industries in Northern Ireland, was until last year head of the Northern Ireland Civil Service. He was Coal Controller for Northern Ireland from 1939 to 1942 and is deputy chairman of the Northern Ireland Coal Importers' Association.

Mr. Selby George, a chargehand at the Rolls-Royce aero-engine works at Derby, has won £175 under the firm's suggestions scheme—the highest award made since the scheme was started. He thought of a new way to economize in the use of wax in the precision investment casting process. Mr. George has been with the firm for 16 years.

Mr. Neville C. Williams has been appointed London manager of Mountstuart Dry Docks, Limited, and associated companies, to work with Mr. V. L. Burke, who is a director of the combine. Mr. Williams served his apprenticeship with Campbell & Isherwood, Limited, Liverpool, as a marine engineer. After a period of 10 years' sea experience with the Cunard Line, he became assistant engineering manager with Harland & Wolff, Limited, Southampton. Later he became assistant superintendent engineer with the Caltex Trading & Transport Company, Limited, which position he has relinquished to take up his new appointment.

Mr. William Gregory Ibberson, of George Ibberson & Company, cutlery and tool manufacturers, Rockingham Street, Sheffield, has been elected the new Master Cutler of the Cutlers' Company in succession to Mr. R. L. Walsh. He became a partner in the firm in 1928, and is chairman of the Skinner Tool Manufacturing Company, Limited, Broad Lane, Sheffield. He was president of Sheffield Chamber of Commerce and Manufacturers in 1952-53, is a member of Sheffield Society of Engineers and Metallurgists, a Liveryman of the Worshipful Company of Blacksmiths and a Freeman of the City of London. He is a direct descendant of Mr. Joseph Ibberson, who was Master Cutler in 1759.

Obituary

The death is announced of Mr. Charles Birch who, until his recent retirement, was managing director of John Birch & Sons, Limited, manufacturers of malleable castings, of Walsall. He succeeded his father as managing director of the firm 44 years ago.

Dr. William Savage Boulton, formerly Professor of Geology in the University of Birmingham, died on September 14 at the age of 87. He was president of the geological section of the British Association in 1916, and a member of the Safety in Mines Research Board from 1922 to 1928.

Mr. Charles Turnbull, the first electrical engineer to serve with Tynemouth Corporation, has died at the age of 84. Mr. Turnbull, who served his apprenticeship with the late Sir C. A. Parsons, was responsible for the establishment of Tynemouth electricity works in 1899. He retired in 1935.

Mr. Robert F. Jones, chairman of Clyde Fuel Systems, Limited, Glasgow, has died. He was well known among marine engineers, heating engineers, and consultants in Glasgow and the West of Scotland. After the war he founded the firm of Clyde Oil Fuel Systems, Limited, in conjunction with the late Mr. J. G. McKean. With the expansion of the company the name was later changed to its present form.

Dr. Edward Langlois Montagnon, who was technical director of Ransomes & Rapier, Limited, engineers and ironfounders, etc., of Ipswich, has died at the age of 69. He was for many years with J. Stone & Company, Limited, until offered a trial by the late Sir Wilfrid Stokes. This trial—without formal agreement—with the company, of which he became chief engineer in 1940 and technical director last year, continued until his death. In 1936 he achieved a Ph.D., London, for a thesis on riveted structures. Dr. Montagnon was a member of the Institution of Civil Engineers. During his service with Ransomes & Rapier, Limited, he was responsible for, or very much concerned with, important work in the field of heavy engineering, his chief interest being in the design of sluice gates and water control equipment. On his appointment as chief engineer he became responsible for the technical efficiency of the company's products, including the great walking dragline completed some two years ago for Stewarts and Lloyds, Limited, at Corby.

The address of Nitralloy, Limited, case-hardening specialists, is now Atlas Works, Sheffield, 4 (telephone: Sheffield 26646).

News in Brief

FIVE TONS of rusty iron crosses from graves in Stafford cemetery are being sold for scrap.

UNDER a barter agreement Japan is to supply ships to Russia in return for 60,000 tons of Russian coal.

PLOWRIGHT BROTHERS, LIMITED, of Chesterfield, have ceased entirely to manufacture iron and brass castings.

THE TELEPHONE NUMBER of the head office of Wellworthy, Limited, has been changed from Lymington 520 to Lymington 2231/8.

THE FOURTH European Machine Tool Exhibition opened in Milan on September 14. Taking part are 800 exhibitors from 12 countries, including the United Kingdom. The exhibition closes today.

A FURTHER £7,000 is to be spent annually by Durham County Education Committee to provide more teachers for mining training centres. The teaching strength in the county is to be raised from 24 to 37.

TUBE INVESTMENTS, LIMITED, announces that, following recent increases in home and overseas demand for certain classes of tubes, it has been found possible to continue production at Jarrow Tube Works, Limited, Jarrow-on-Tyne.

CLEARANCE WORK has begun on a 20-acre site at Solihull for the building of a new factory for the rapidly expanding Rover Company, Limited. The project involves premises covering about 10,000 sq. ft. with adjoining space for a car park.

THE average selling price (to the nearest 10s.) of members of the Federation of Light Metal Smelters for the following alloys during the month of August has been calculated as follows:—LM1, £143 10s. per ton; LM2, £153 10s.; LM4, £160 10s.; LM6, £181 10s.

THE COMMERCIAL MOTOR SHOW, which opens to-morrow at Earls Court, London, presents an extensive range of general, public service and special-purpose vehicles. Hours of admission are from 10 a.m. to 9 p.m. (Sundays excepted), and the Show remains open until October 2.

A CONFERENCE on radiation hazards in industry will be held in London on November 1 by the British Occupational Hygiene Society. Particulars of the papers to be presented can be obtained from Mr. P. C. G. Isaac, Public Health Engineering Laboratory, King's College, Newcastle-upon-Tyne.

DAVY & UNITED ENGINEERING COMPANY, LIMITED, Sheffield, has received another order from Dorman Long for a further section of their development schemes. The new contract is for the supply of primary cooling-banks complete with all approach and run-out tables for the Cleveland section mill.

THE LIGHT CASTINGS industry in the Falkirk district it is reported, will be assured of more work from inquiries which have come from Australian and New Zealand buyers and agents from Middle East countries. An order for 500 baths for Australia for the Carron Company will be confirmed if delivery dates can be approved.

THE ADMIRALTY SALVAGE ORGANIZATION have now successfully completed the final stage of the salvage operations on the French destroyer Maille Breze, and the vessel has been handed over to Turner & Hickman, Limited, shipbrokers, Glasgow. The Maille Breze will then be transferred to the Port Glasgow firm of Smith & Houston, Limited, to be broken up.

CHAMBERLAIN INDUSTRIES, LIMITED of Staffa Works, London, E.10, have recently appointed Drummond Asquith (Sales), Limited of King Edward House, New Street, Birmingham, 2, as sole distributors in the United Kingdom of the production tube-bending machinery which they design and manufacture in conjunction with Walter P. H. Hill Inc., of Detroit, Michigan, U.S.A.

A LARGE ORDER for Diesel and dual-fuel engines has recently been placed with the National Gas & Oil Engine Company, Limited, by the Kellogg International Corporation. This equipment will be supplied to Imperial Chemical Industries, Limited, for driving compressors at its No. 2 Olefine Plant at Wilton (Yorks). The total power involved is approximately 11,000 b.h.p., to be obtained from 13 engines.

THE BOARD OF TRADE announce that a new Trade Commissioner Office will be opened in Bulawayo, Southern Rhodesia on October 1. Mr. J. Stafford, assistant to the United Kingdom Trade Commissioner at Salisbury, Southern Rhodesia, will be in charge. The temporary address is c/o Mr. J. A. Clark, P.O. Box 1776, 515 Bradlow's Buildings, Abercorn Street, Bulawayo. There will not now be a U.K. trade correspondent at Bulawayo.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED, will be exhibiting on stand 65 at the Purchasing Officers' Association "Minibition" to be held at the Royal Hall, Harrogate, from September 30 to October 2. Their display will include low-, medium- and high-voltage cables, rubber and plastic cables and flexibles, paper pinions, copper sheets and sections. A comprehensive range of winding wires will also be on show.

MR. ROBERT PATTERSON, the furnaceman whose dismissal from his employment at the Coventry factory of Sterling Metals, Limited, on September 9 caused 600 fellow workers to strike, is to be reinstated. This decision was reached on September 14 during talks between representatives of the strikers and the firm's management. Mr. Patterson has worked for Sterling Metals for 18 years.

THE WEST MIDLAND GROUP of the British Association for Commercial and Industrial Education is organizing a conference in Birmingham on September 28 with the theme "Schoolboy into soldier: is the challenge being met?" It is thought in some quarters that industry might start "trainee ships" to give youths who are unable to aspire to apprenticeships a sense of continuity which would keep them from "drifting."

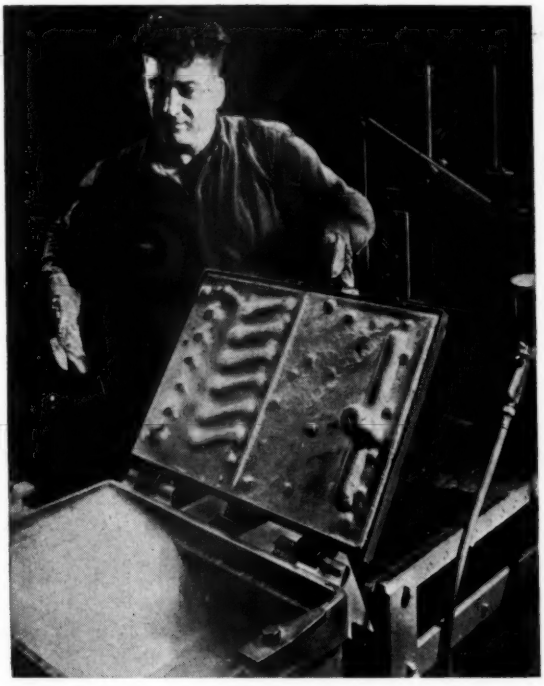
EXPORTS of iron and steel from the United States in the first six months of this year dropped in value to $243,000,000, compared with $267,000,000 in the second half of 1953. While exports of special industrial machinery rose to $409,000,000 ($386,000,000), metalworking machinery and machine tools fell to $110,000,000 ($156,000,000), and construction, mining, and oil-industry machinery dropped to $224,000,000 ($266,000,000).

LORD FALMOUTH, president of the Cornish Engines Preservation Society, laid a laurel wreath at the base of the 80-in. pumping engine at Robin's Shaft, South Crofty tin mine, Camborne, on Saturday, to commemorate its 100th year of working life. The engine is shortly to be replaced by powerful centrifugal pumps, but the society is hoping to preserve this or the only other Cornish pumping engine now operating, which is in use at the nearby East Pool mine.

ENGINEERING FIRMS can reduce normal hours from 44 to 37½ a week and save six per cent. in the cost of an

(*Continued on page* 366)

SHELL MOULDING QUERIES
No. 2



On the question of STOVES

"*We would like you to express an opinion as to whether you think these machines have reached the stage of making economically light castings suitable for stove grade work.*"

This is the kind of query with which we are dealing every day regarding the Shelmolda 'Duplus.' We shall be pleased to help you with your problems.

The Shelmolda 'Duplus' has an output of 50 to 60 moulds per hour. It costs £575 and delivery is 8 to 10 weeks.

Shelmolda
DUPLUS

PATENT APPLIED FOR

FAIRBAIRN LAWSON COMBE BARBOUR LTD

LEEDS, ENGLAND. Telephone: Leeds 32041

236.67A

News in Brief

(*Continued from page* 364)

article by introducing two day shifts—between 6 a.m. and 10 p.m., Mr. A. B. Waring, managing director of Joseph Lucas, Limited, told a joint meeting of the Institution of Production Engineers and Birmingham Productivity Association in Birmingham on September 15. Mr. Waring said that every saving in the direct labour cost of an article by better production methods was worthwhile because of the chain of after-effects.

GUY MOTORS, LIMITED, of Fallings Park, Wolverhampton, celebrated its 40th birthday on September 14, and its founder, Mr. Sydney S. Guy, entertained customers and friends at the factory to see a special anniversary display of vehicles. Before founding Guy Motors, Limited, Mr. Sydney Guy had been works manager of the Sunbeam Motor Company, Limited, and he has since been chairman and managing director. The original factory of Guys at Fallings Park has been extended to cover an area of more than 14 acres and nearly 2,000 operators are employed.

THIRTY FIRMS have been registered as members of the newly formed Association of Vermiculite Exfoliators the aims of which are "to promote, support, develop and maintain the vermiculite industry in general, particularly in regard to the exfoliation thereof and the interests of those engaged therein." Vermiculite is a product of mica. Mined largely in South Africa, it is exfoliated by being put through a furnace which at once expands and lightens it. It is used as an insulating material, and has been proposed for several foundry applications, including insulation of feeder heads.

AT THE CONCLUSION of the second day of his tour of Black Country industries on September 14, Sir Edward Boyle, Parliamentary Secretary to the Ministry of Supply, said he had been most impressed both with the castings and the forgings produced. Sir Edward visited Beans Industries, Limited, Henry Wiggin & Company, Limited, and Garringtons, Limited. Commenting on joint consultation, Sir Edward said that everywhere he had been, he had spoken to shop stewards about the subject and from everything he had heard, it seemed to be proceeding very well.

WELLWORTHY, LIMITED, will be showing a complete range of their products for the car manufacturer and car user at the Earls Court Motor Show on Stand 387. Pistons of every type will be featured, including the "Al-Fin" piston where an austenitic-iron top-ring groove-carrier is molecularly bonded into the body of an aluminium piston. This ensures that the ring groove is virtually free from wear and consequently much greater mileages can be achieved before engine overhaul is necessary. Other exhibits include piston rings, cylinder liners, "Al-Fin"-bonded light-alloy brake drums and other Al-Fin products; valve-seat inserts, etc.

THE OWEN FALLS CONSTRUCTION COMPANY, of Jinja, Uganda, have appointed George Cohen, Sons & Company, Limited, of Wood Lane, London, W.12, as sole selling agents for the disposal of the very large quantity of modern civil-engineering plant used for the construction of the Owen Falls hydro-electric scheme. It will be recollected that the vast Owen Falls dam was opened by Her Majesty the Queen on April 29 and the whole scheme, which marks an important stage in the plan to utilize the full hydro-potential of the Nile, has excited world-wide interest. Sand washing, crushing and screening plant is among the hundreds of items to be sold.

AN INTER-WORKS COMPETITION of sports and games, known as the President's Trophy Competition, is promoted yearly between the three factories comprising the Allied Ironfounders, Limited, Shropshire—Aga Heat, Limited, Allied Iron, Ketley, and Coalbrookdale Company. This year's activities culminated in the President's Day held at the Aga Heat Works, Ketley, on September 11. Mrs. W. T. Wren (wife of Mr. W. T. Wren, managing director, Allied Ironfounders, Limited, London), presented a shield, the gift of the presidents and vice-presidents, to Mr. G. F. Williams, of Coalbrookdale, the Coalbrookdale Company again being the competition winners for the fifth year in succession.

ABOUT 60 EMPLOYEES of Mechans, Limited, engineers, Scotstoun Iron Works, Glasgow, have been informed that they will be paid off early in the new year. Under a scheme of reorganization two small departments are to be closed. Besides giving the workers three months' warning of dismissal, the firm are doing everything possible to find other employment, in consultation with the Ministry of Labour. The sections which are to close are the brass and ships'-telegraph department and the motor frame department. While the departments had sufficient work to last until the end of the year, they were uneconomic, an official of the firm said. Apart from that aspect, he added, the reorganization was being brought about by a long-term change in the pattern of the firm's production.

TWO HUGE ELECTRICALLY-OPERATED TRANSPORTERS, each weighing 600 tons and of unique design, have recently been put into operation at Bidston Dock, Birkenhead. Constructed by Joseph Booth & Bros., Limited, the transporters are to be used for unloading iron ore from ships at the dockside into waiting road, rail or barge transport for despatch to the Hawarden Bridge Steel Works, near Shotton, of John Summers & Sons, Limited. Each grab has a capacity of six tons and the time taken to pick up and discharge a grab-load is 60 sec., giving each transporter a capacity of over 350 tons an hour. The complete current-collection equipment has been designed, manufactured and installed by British Insulated Callender's Cables, Limited, and its subsidiary British Insulated Callender's Construction Company, Limited, in association with R. & J. H. Rea, Limited, Joseph Booth & Bros., and Wm. Cory & Sons, Limited.

SINCE ITS FORMATION, last year, the Midland Group for the Presentation of Technical Information has explored various means of improving the communication of technical information by specialists to others outside their field who should know of it. The 1954-55 programme of the Group deals with several of the methods—including films, photography, technical writing and so on. At the first meeting to be held in Birmingham on October 6, Dr. W. G. Thompson, manager of the Witton laboratories of the G.E.C. Company, will speak on the problems encountered in improving the standard of technical presentations in research reports, and on November 3, five films will be shown to demonstrate different ways of putting over technical subjects. Mr. N. W. R. Mawle, managing director of British Typewriters, Limited, West Bromwich, will deal on January 5 with the application of technical presentation in sales promotion, and subjects of other meetings include assessing the capacity of potential technical writers, teaching the art of communication, the function of the technical writer in industry, the place of photography in technical presentation and presenting technical affairs as an instrument in public relations.

Hot blast for cupolas ....

HERE ARE SOME FACTS ABOUT THE

M.E.

HOT BLAST CUPOLA PLANT

1 There are more M.E. plants running in Great Britain than any other make.

2 They are wholly designed in Great Britain and from now on will be wholly manufactured here, including the " Schack " recuperator.

3 They can be specified to deliver any blast temperature, from 200° C. to 800° C., and the blast temperature is automatically controlled.

4 There is an M.E. plant for any size of cupola, from 1½ tons/hr. to 30 tons/hr. or more.

5 They can be recuperative, separately fired, or initially separately fired and later adapted to recuperation, as desired.

6 They incorporate the most modern developments in water cooling, slag granulation, drop handling, charging, etc.

7 With each plant full metallurgical advice is given. M.E. plants have been installed in grey iron, whiteheart malleable, blackheart malleable, cylinder iron, and die-cast foundries.

Full information from:

METALLURGICAL ENGINEERS LTD.

GRANITE HOUSE, CANNON STREET, LONDON, E.C.4

TELEPHONE CITY 7072

Pig-iron and Steel Production

Statistical Summary of July Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past six months. Table II gives production of steel ingots and castings in July, and Table III, deliveries of finished steel in June, 1954. Table IV gives the production of pig-iron and ferro-alloys in July, 1954, and furnaces in blast. (All figures weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production*

Period.	Price Index, 1938 = 100.			Iron-ore output.	Imptd. ore used.	Coke to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	I. & S.	Coal.	All comdts.						Imports.[1]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[2]
1952[3] ..	254	329	323	306	190	228	202	171	29	310	252	683
1953	260	350	323	304	207	237	215	188	18	339	262	962
1954—Feb. ..	259	359	322	302	230	240	222	201	14	357	290	902
March[4]	260	360	324	322	232	238	231	203	16	365	291	898
April ..	260	360	325	312	236	243	232	200	4	368	272	945
May ..	261	365	326	306	236	240	231	208	4	375	288	927
June[4]	265	365	328	289	239	240	233	204	4	372	274	1,011
July ..	265	365	328	284	213	227	211	142	4	263	—	1,080

TABLE II.—*Production of Steel Ingots and Castings*

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby., Leics., Notts., Northants and Essex ..	—	3.2	10.7 (basic)	1.6	0.2	14.9	0.8	15.7
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire	0.8	23.0	—	1.7	0.3	24.9	0.9	25.8
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	27.0	—	—	0.1	27.0	0.1	27.1
North-East Coast	0.8	53.8	—	1.0	0.3	54.5	1.4	55.9
Scotland	1.3	20.1	—	0.5	0.5	21.3	1.1	22.4
Staffs., Shrops., Worcs. and Warwick	—	14.6	—	1.1	0.5	14.6	1.6	16.2
S. Wales and Monmouthshire	4.4	51.8	6.2 (basic)	1.2	0.1	63.0	0.7	63.7
Sheffield (incl. small quantity in Manchester) ..	6.0	17.1	—	7.1	0.4	29.1	1.5	30.6
North-West Coast	—	1.0	4.2 (Acid)	0.4	0.1	5.6	0.1	5.7
Total	13.3	211.6	21.1	14.6	2.5	254.9	8.2	263.1
June, 1954[4]	20.0	306.2	24.6	17.6	3.3	361.6	10.1	371.7
July, 1953	15.3	226.6	18.0	14.0	2.7	268.4	8.2	276.6

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel.*

Product.	1952.[4]	1953.	1953.	1954.	
			June[4]	May.	June.[4]
Non-alloy steel:					
Ingots, blooms, billets and slabs[5]	4.5	4.7	3.7	5.3	5.5
Heavy rails ..	8.0	8.7	9.5	10.5	9.7
Sleepers, etc. ..	1.8	2.2	2.6	2.4	2.0
Plates, 3 mm. thick and over ..	41.4	46.5	49.6	50.4	46.2
Other rolled prod...	39.0	43.9	44.3	48.1	47.0
Wire rods, rods, bars, coiled ..	15.9	15.6	13.8	20.7	19.1
Light rolled prod...	46.0	49.3	50.6	46.6	47.6
Bright steel bars	6.5	6.7	6.5	6.2	5.6
Hot-rolled strip ..	18.8	18.8	17.9	23.4	20.7
Cold-rolled strip ..	6.1	5.2	4.8	7.1	7.4
Sheets, incl. coated	31.7	34.1	35.7	43.4	39.2
Tinplate, terneplate and blackplate ..	16.0	14.9	13.9	17.0	17.8
Steel tubes, pipes	20.1	20.1	20.0	21.9	19.8
Tube, pipe fitgs.	0.4	0.3	0.3	0.4	0.4
Tyres, wheels, axles	3.5	4.4	4.4	4.8	4.7
Forgings (excl. drop forgings) ..	2.8	3.1	3.0	2.8	2.5
Steel castings ..	4.2	4.0	4.0	3.8	3.8
Tool and magnet steel	0.3	0.3	0.3	0.2	0.2
Total	267.0	282.8	284.9	315.0	299.2
Alloy steel	13.4	13.7	12.2	13.8	12.5
Total deliveries from U.K. prod.[6] ..	280.4	296.5	297.1	328.8	311.7
Add: Imported finished steel ..	12.9	6.8	4.9	2.2	2.2
Deduct: Intra-industry conversion[7] ..	42.7	42.6	41.2	44.3	41.0
Total net deliveries of new material ..	250.6	260.7	260.8	286.7	272.9

TABLE IV—*Production of Pig-iron and Ferro-alloys*

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby., Leics., Notts., Northants and Essex	24	—	16.6	24.1	0.6	—	41.3
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire ..	3	—	15.3	—	—	0.8	16.1
Yorkshire (incl. Sheffield, excl. N.E. Coast) ..							
Lincolnshire ..	10	—	29.7	—	—	—	29.7
North-East Coast	24	4.5	44.1	0.1	—	1.3	50.0
Scotland	9	0.9	13.7	1.6	—	—	16.2
Staffs., Shrops., Worcs., and Warwick ..	9	—	8.7	1.6	—	—	10.3
S. Wales and Monmouthshire	9	4.9	24.4	—	—	—	29.3
North-West Coast	7	17.2	—	—	—	1.1	18.3
Total ..	95	27.5	152.5	27.4	0.6	3.2	211.2
June, 1954[4] ..	102	27.9	172.9	27.8	0.9	3.7	233.2
July, 1953 ..	105	28.5	144.6	24.8	1.0	3.5	202.4

[1] Weekly average of calendar month.
[2] Stocks mainly ingots and semi-finished at the end of the years and months shown.
[3] Average 53 weeks ended January 1953, all tables.
[4] Five weeks, all tables.
[5] Other than for conversion into any other form of finished steel listed
[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[7] Material for conversion into other products also listed in this table.

FIRST WITH W20

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This new synthetic resin core-binder has been specially developed to suit those foundries where fumes and casting odours cause embarrassment. The result of practical co-operation between B.I.P. and leading foundries, Beetle W42 is another example of B.I.P.'s pioneer research and service to the Foundry Industry. W42 has been formulated with the Garrett Report in mind and it possesses all the advantages of Beetle Resin W20, coupled with this important new feature . . .

reduced casting odour

* *Patent Application 32896/58*

B·I·P GROUP

Write for technical information to British Industrial Plastics Ltd., Tat Bank House, Oldbury, Nr. Birmingham

London Office: 1 Argyll Street, W.1. *'Beetle' is a trade mark registered in Great Britain and in most countries of the world.*

Raw Material Markets

Iron and Steel

Pig-iron production last month was within measurable distance of the record level reached in May. It was 16,200 tons a week better than in the previous month and 23,000 tons a week higher than in August, 1953. This sharp rise has encouraged hopes that the gap between supply and demand will soon be bridged, but there is still an urgent demand for prompt tonnages. Apart from the growing requirements of the steel plants, foundries are seeking increased supplies. There has been a marked improvement in the flow of orders for domestic castings and employment in the light foundries is now restored to normal. Activity in the engineering and speciality foundries is maintained at a high level, and deliveries of the better grades of pig-iron, such as hematite and low- and medium-phosphorus irons, are barely sufficient for current needs.

There has been a dramatic change in the fortunes of the re-rolling industry. A month or two ago the light mills were short of work; now re-rollers of small bars and light angles have an abundance of work in hand to keep them busy for at least three months ahead and the strip mills have even heavier commitments, while the whole of the prospective output of sheets to the end of the year is already sold. Requirements of the mills for billets, blooms, sheet bars, and slabs are correspondingly increased, but British steelmakers have hitherto been able to handle all requirements without resort to the importation of marginal tonnages from the Continent.

A sharp recovery in the export trade in finished-steel products has synchronized with an expansion of home demand which has exceeded the most sanguine anticipations. As a result, stocks have been freely drawn upon, and as order-books became more and more congested, delivery dates lengthen. An outstanding feature of the steel trade is the demand for heavy joists and sections, which are no longer obtainable for reasonably early delivery. Pressure for plates has again become intense, and to avoid home shortages, export business has been restricted. Makers of tubes have very substantial export orders on their books, and there is an eager market for wire rods.

Non-ferrous Metals

Apart from copper, which showed great strength in advancing by £8 10s. for cash and £5 5s. for three months, price movements on the Metal Exchange last week were not spectacular. Tin gained £7 for cash and £5 10s. forward, while zinc closed 17s. 6d. up for September and 20s. better for December. Lead, helped by a ¼ cent advance in the U.S. price to 14¼ cents, gained £2 for the current half month, but was only up by 10s. for second half December. The backwardation, which a week earlier was 25s., widened to £2 15s.

In the United States, Customs smelter copper was reported on sale at 31 cents and the Commodity Market showed great strength, with sellers of September at 31 cents and of October at 31½ cents on last Friday's trading session, when some 375 tons changed hands. While the strike position has improved in the U.S.A., last week ended with the Garfield smelter idle due to a stoppage of operatives, as a result of which a monthly production rate of about 20,000 tons is being lost. It is going to take a long time for the upset caused by the widespread strikes to be overcome and quotations must obviously remain high.

Fortunately, in Chile the position has improved as a result of the workers' agreement to arbitration at Chuquicamata and El Tenjente. The situation is, however, rather tense and is likely to remain so for some time in view of the condition of inflation in Chile and the ever-recurring demands for higher wages. In London we may expect some easing of the quotation, but it will be surprising if the price of cash copper on the Metal Exchange goes below £240 this year. Three months ought to move downwards, but the backwardation will persist, it is feared, for many months. The scrap market here has been partially disorganized for values shot up to assume rather an unrealistic level.

Official metal prices were as follow:—

COPPER, Standard—*Cash:* September 16, £250 to £251; September 17, £253 to £253 15s.; September 20, £253 10s. to £254; September 21, £254 10s. to £255 10s.; September 22, £260 to £261.

Three Months: September 16, £242 to £242 10s.; September 17, £244 to £244 5s.; September 20, £243 to £243 5s.; September 21, £244 to £244 10s.; September 22, £246 10s. to £247.

TIN, Standard—*Cash:* September 16, £736 to £736 10s.; September 17, £738 10s. to £739; September 20, £738 to £738 10s.; September 21, £737 to £737 10s.; September 22, £735 10s. to £736.

Three Months: September 16, £736 to £737; September 17, £738 to £739; September 20, £738 to £738 10s.; September 21, £736 10s. to £737; September 22, £735 to £736.

ZINC—*Second half September:* September 16, £80 15s. to £81; September 17, £80 15s. to £81; September 20, £80 15s. to £81; September 21, £80 10s. to £80 15s.; September 22, £80 10s. to £80 15s.

Second half December: September 16, £80 10s. to £80 15s.; September 17, £80 15s. to £81; September 20, £80 15s. to £80 17s. 6d.; September 21, £80 7s. 6d. to £80 10s.; September 22, £80 10s. to £80 12s. 6d.

LEAD—*Second half September:* September 16, £101 15s. to £102 5s.; September 17, £102 to £102 5s.; September 20, £101 5s. to £101 10s.; September 21, £100 15s. to £101; September 22, £101 to £101 5s.

Second half December: September 16, £99 15s. to £100; September 17, £99 10s. to £99 15s.; September 20, £99 to £99 5s.; September 21, £98 10s. to £99; September 22, £98 15s. to £99.

Institute of Welding

The Autumn Meeting of the Institute of Welding will be held in London from October 27 to 29. The programme includes the presidential address by Mr. R. G. Braithwaite, M.I.C.E. and presentation of the C. W. Hill Prize (1953). The annual dinner is to be held on October 27 at the Park Lane Hotel, Piccadilly, London, and the discussion meetings at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1. Further details may be had on application to the secretary of the Institute (Mr. G. Parsloe), 2, Buckingham Palace Gardens, London, S.W.1.

Correction. In the "News in Brief" column of last week's issue it was stated that Oxley Engineering Company had disposed of their subsidiary, A. & W. H. Bury (Darwen), Limited, to J. Vickers & Son, Limited, Darlington. This is not correct, A. & W. H. Bury having been sold to J. Vickers & Son, Canal Foundry, Church, near Accrington. Apologies are tendered to the firms concerned and to readers who may have been confused.

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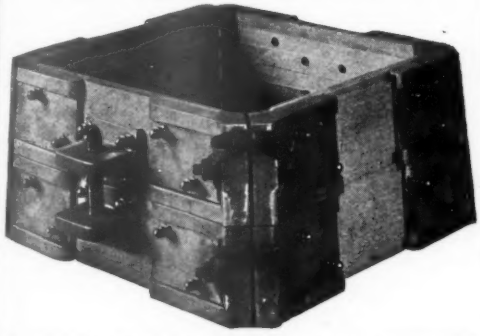

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British steel leads the world

THE BRITISH IRON AND STEEL FEDERATION

S.83

Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

September 22, 1954

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £14 19s. 6d.; Birmingham, £14 12s. 9d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £17 5s. 9d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 16s. 9d.

Scotch Iron.—No. 3 foundry, £17 9s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 19s. 6d.; South Zone, £19 2s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 19s. 6d.; South Zone, £20 2s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £17 14s. 6d.; Scotland (Scotch iron), £18 1s. 0d.; Sheffield, £18 19s. 0d.; Birmingham, £19 6s. 6d.; Wales (Welsh iron), £18 1s. 0d.

Basic Pig-iron.—£15 10s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered)

Ferro-silicon (6-ton lots).—40/55 per cent., £42 0s. 0d., basis 45 per cent. Si, scale 17s. per unit; 70/84 per cent., £65 0s. 0d., basis 75 per cent. Si, scale 18s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. 0d. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. 0d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £185 9s. 0d. to £195 0s. 0d. per ton; 38/40 per cent., £251 0s. 0d. to £270 0s. 0d. per ton.

Ferro-tungsten.—80/85 per cent., 14s. 2d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 17s. 2d. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £75 0s. 0d. to £80 0s. 0d., basis 60 per cent. Cr, scale 25s. 0d. per unit ; over 6 per cent. C, £74 0s. 0d. to £76 0s. 0d., basis 60 per cent. Cr, scale 24s. 0d. per unit; max. 2 per cent. C, 1s. 7½d. per lb. Cr; max. 1 per cent. C, 1s. 8d. per lb. Cr; max. 0.15 per cent. C, 1s. 9½d. per lb. Cr; max. 0.10 per cent. C, 1s. 9¾d. per lb. Cr; max. 0.06 per cent. C, 1s. 10d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 6s. 6½d. to 7s. 1d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £225 0s. 0d. to £232 0s. 0d. per ton; 96/98 per cent., £255 0s. 0d. to £262 0s. 0d. per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 52s. 6d. to 70s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £54 15s. 0d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C, £26 12s. 6d.; hard (0.41 to 0.60 per cent. C), £28 0s. 0d.; silico-manganese, £33 16s. 0d.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s. 0d.; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s. 0d.; acid, up to 0.25 per cent. C, £33 0s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £31 1s. 6d.; boiler plates (N.-E. Coast), £32 9s. 0d.; floor plates (N.-E. Coast), £32 10s. 6d.; sectional material, N.-E. Coast, £29 4s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 7s. 0d.; flats, 5 in. wide and under, £32 7s. 0d.; hoop and strip, £33 9s. 0d.; black sheets, 17/20 g., £42 1s. 0d.; galvanized corrugated sheets, 24 g., £51 8s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £53 8s. 0d.; nickel-chrome, £75 2s. 0d.; nickel-chrome-molybdenum, £84 13s. 6d.

NON-FERROUS METALS

Copper.—Cash, £260 0s. 0d. to £261 0s. 0d.; three months, £246 10s. 0d. to £247 0s. 0d.; settlement, £261 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 29½d. per lb.; wire, 284s. 9d. per cwt. basis; 20 s.w.g., 316s. 6d. per cwt.

Tin.—Cash, £735 10s. 0d. to £736 0s. 0d.; three months, £735 0s. 0d. to £736 0s. 0d.; settlement, £736 0s. 0d.

Zinc.—Second half September, £80 10s. 0d. to £80 15s. 0d. second half December, £80 10s. 0d. to £80 12s. 6d.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £111 5s. 0d.; rolled zinc (boiler plates), all English destinations, £109 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £96 0s. 0d.

Lead (Refined Pig).—Second half September, £101 0s. 0d. to £101 5s. 0d.; second half December, £98 15s. 0d. to £99 0s.

Brass Tubes, etc.—Solid-drawn tubes, 24d. per lb.; rods, drawn, 33½d.; sheets to 10 w.g., 269s. 9d. per cwt.; wire, 31½d.; rolled metal, 256s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £172; B6 (85/15), £220; BS249, £180.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £205; HTB2 (38 tons), £213; HTB3 (48 tons), £230.

Gunmetal.—RCH, 3/4 per cent. tin, £196; BS1400, LG2 (85/5/5/5). £210; LG3 (86/7/5/2), £217; G1 (88/10/2/½), £288; (88/10/2/1), £274.

Phosphor Bronze.—BS1400, PB1 (AID released), £298 per ton.

Phosphor Bronze Strip, etc.—Strip, 380s. 3d. per cwt.; sheets to 10 w.g., 402s. 9d. per cwt.; wire, 47½d. per lb.; rods, 41d.; tubes, 39½d.; chill cast bars: solids 41½d., cored 42½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 2½d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 8d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 7d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £105 0s. 0d. Nickel, £483 0s. 0d. Aluminium, ingots, £156 0s. 0d.; aluminium bronze (BS1400), AB1, £257; AB2, £264. Solder, brazing, BS1845, 1s. 11d. lb.; granulated, 2s. 2d. lb.

Forthcoming Events

SEPTEMBER 28

Institution of Production Engineers

Luton section:—" Photography in Industry," by W. Harvey, 7.15 p.m., in the Small Assembly Room, of the Town Hall.

SEPTEMBER 29

Institute of British Foundrymen

London branch:—" Casting of an Aluminium Wheel," film and Paper presented by J. R. Harrison at the Waldorf Hotel, Aldwych, London, W.C.2. Preceded by a Council meeting.

Institution of Production Engineers

Birmingham section:—" Fawley Experiment—Construction of the Esso Refinery," by Mark Abrams, 7 p.m., at the College of Technology, Suffolk Street.

SEPTEMBER 30

Incorporated Plant Engineers

Sheffield and District branch:—" Fuel Conservation "—a a Brains Trust, chairman Sir Oliver Lyle, O.B.E., 7.30 p.m., at the Grand Hotel.

Institution of Production Engineers

Lincoln section:—" How the Production Engineer can be Helped by the Metallurgist," by Dr. J. D. Jevons, 7.30 p.m., at the Ruston Club, Unity Square.

South Wales and Monmouthshire section: Film evening, at the South Wales Institute of Engineers, Park Place, Cardiff.

Engineers' Guild

Sixth annual general meeting, 6 p.m., at Caxton Hall, Westminster, London, S.W.1.

OCTOBER 1

Institution of Production Engineers

Birmingham section:—Annual dinner dance at the Botanical Gardens, Edgbaston, Birmingham.

British Trade Fair, Copenhagen

A British trade fair, organized jointly by the British Import Union of Denmark and the Federation of British Industries, is to be held at Copenhagen from September 29 to October 16, 1955. Her Majesty Queen Elizabeth II and His Majesty King Frederik IX of Denmark have graciously agreed to grant their patronage to the fair, which has the full support of both Governments.

Similar British trade fairs were organized by the B.I.U. and the F.B.I. at Copenhagen in 1932 and 1948. On the last occasion there were over a thousand exhibitors and over a million visitors. This time the F.B.I. is making available the services of its newly-formed subsidiary company, British Overseas Fairs, Limited, 21, Tothill Street, London, S.W.1. The company's exhibition organizer, Mr. D. A. Lamb, will be manager of the Copenhagen Fair, with a Danish assistant, and the company will be responsible for all arrangements in the United Kingdom, including the sale of space.

Northampton Polytechnic Courses

Following their well-established practice of providing high-grade courses on special technological subjects, the Northampton Polytechnic, St. John Street, London, E.C.1, has arranged for a series of lectures to be given on " Chemical and Metallurgical Thermodynamics " by Dr. O. Kubaschewski; " Corrosion and Packaging " by a team of lecturers and " Refractories—their Manufacture, Properties and Uses " by Mr. L. R. Barrett. Details of the times and costs may be obtained by writing to Dr. J. E. Garside, the head of the Department of Applied Chemistry, at the address quoted.

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NOTICE

Replies to Box Numbers to be addressed to "Foundry Trade Journal," 49, Wellington Street, London, W.C.2.

SITUATIONS WANTED

EXECUTIVE, specialising in Shot-blast Plant of the Impeller type, seeks similar position with a progressive firm desirous of widening its scope. Can bring the manufacturing and selling rights for G.B. and certain other countries of plant of advanced Continental design.—Box ES758, FOUNDRY TRADE JOURNAL.

YOUNG MAN (24), Moulder, City & Guilds, National Cert., experience in locomotive and general engineering castings, desires situation, with reasonable prospects. Anything in foundry trade considered.—Box YM760, FOUNDRY TRADE JOURNAL.

FOUNDRY TECHNICAL SUPERVISOR seeks progressive position. Grey iron and high duty iron. 20 years' experience—all phases. Casting design to customer contact. Sand and metallurgical training. Time study experience. Minimum salary £1,200.—Box FT791, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through a Local Office of the Ministry of Labour or a Scheduled Employment Agency if the applicant is a man aged 18-64 inclusive or a woman aged 18-59 inclusive unless he or she, or the employment, is excepted from the provisions of the Notification of Vacancies Order, 1952.

FOUNDRY PLANNING ENGINEER, for North Midland's Foundry making automobile castings, must possess initiative and have a progressive outlook. Give full particulars of experience, age and salary required. Box FP768, FOUNDRY TRADE JOURNAL.

FOUNDRY SUPERINTENDENT, for automobile Iron-Foundry producing high quality castings. Applicant must possess initiative, be progressive in outlook, able to control labour. State age, experience and salary required. Box FS769, FOUNDRY TRADE JOURNAL.

MANAGER wanted to take over control of Modern Mechanised Section of Grey Iron Foundry in West Riding of Yorkshire. Applicants must be thoroughly practical and experienced in production of precision and high class light to medium weight castings. This position offers good prospects for the right type of man. Applications in confidence, stating age and experience.—Box MW761, FOUNDRY TRADE JOURNAL.

REPRESENTATIVE.

TECHNICAL SALESMAN for Shot Blast Plants, etc. Knowledge of Welded Work an advantage, but not essential. Car Provided. Apply by letter only, stating experience, age and salary. ST. GEORGE'S ENGINEERS LIMITED, Ordsall Lane, Manchester, 5.

METALLURGIST (25 to 30), required to take charge of laboratory and control of mixtures in Midland foundry producing iron castings by the centrifugal process. Must be keen and energetic. Man with practical foundry experience preferred. Write giving details of experience, age and salary required. Box MR770, FOUNDRY TRADE JOURNAL.

SITUATIONS VACANT—*contd.*

EXPERIENCED PLATE AND MACHINE MOULDERS required. Capable of earning up to £15 per week at piece work rates. Caravan accommodation can be shared with other employees.—Write: KINGSWORTHY FOUNDRY CO., LTD., Winchester, Hants.

PATTERNMAKERS required, used to first-class Wood and Metal work. Excellent conditions, canteen, music while you work, etc., top wages and bonus, by the oldest (85 years) established firm, with the absolute highest reputation. Main suppliers for many years to all firms of importance in the entire country and the finest Plant and Equipment in the world.—Apply WRIGHT & PLATT, LTD., the World's Largest Engineering Patternmakers, Irving Street, Birmingham. Vacancies at Manchester branch. Apply Springfield Lane Works, Salford, 3.

REPRESENTATIVE required for the sale of Steel Castings in Lancashire and Yorkshire. Applicants must have knowledge of steel founding, and preferably a connection amongst purchasers of Steel Castings.—Applications, in confidence, to the SECRETARY, Samuel Osborn & Co., Ltd., P.O. Box No. 1, Sheffield, stating age, experience, and salary required.

A FOUNDRY FOREMAN is required by NEWTON CHAMBERS & CO., Sheffield, for Foundry specialising in castings for light engineering and vitreous enamelled products. Good foundry experience is essential, and it is desirable that applicants should have experience of supervising both mechanised plant and floor moulding production.—Please reply, listing details of age, experience, etc., to PERSONNEL OFFICER, Newton Chambers & Co., Ltd., Thorncliffe, Sheffield.

A FOREMAN PATTERNMAKER is required by NEWTON CHAMBERS & CO., Sheffield, for the Mechanised Foundry of the Light Castings Department. Applicants should have sound engineering patternmaking experience, including mechanised plant process, as the emphasis will be on metal pattern equipment. This is a staff post, and there are good prospects.—Please reply, listing details of age, training, experience, etc., to PERSONNEL OFFICER, Newton Chambers & Co., Ltd., Thorncliffe, Sheffield.

FOUNDRY MANAGER required by old Engineering Co. in the Midlands for Steel Foundry specialising in Precision Castings. Position offers excellent future prospects for applicant with drive and initiative, coupled with sound practical background. State in confidence full particulars of career to date, age, and salary required to Personnel Manager.—Box FM790, FOUNDRY TRADE JOURNAL.

SALES MANAGER required for medium size Foundry in Bristol. Must have close contacts with industry. Progressive position.—Box SM789, FOUNDRY TRADE JOURNAL.

WANTED immediately, for works in South Midlands, first-class DESIGN DRAUGHTSMAN, for Dust and Steam Extraction Plant. Good structural experience necessary.—Apply, stating age and salary required, to Box WM787, FOUNDRY TRADE JOURNAL.

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SITUATIONS VACANT—*contd.*

FOUNDRY FOREMAN required, to take charge of Grey Iron Foundry. Must be used to the manufacture of Cast Iron Pipes and good quality general engineering Castings. Must be first-class man. House available after probationary period. —Write, giving details of experience and salary required, to:—A. BARTON (ENGINEERS), LTD., Providence Foundry and Engine Works, St. Helens Junction, Lancashire.

LOOSE PATTERN MOULDERS, preferably with apprenticeship and experience of small accurate work, required by Malleable Iron Foundry.—Apply BRITANNIA IRON & STEEL WORKS, LTD., Bedford.

A MEDIUM sized Engineering Factory requires a qualified Metallurgist able to take full control of ferrous and non-ferrous Foundry. Ideal opening for graduate with practical experience of managing a Production Dept. Reply to BOX AM756, FOUNDRY TRADE JOURNAL.

A PRACTICAL non-ferrous foreman required, capable of improving production of small foundry in home counties. Good prospects for bright man with experience. Write full details of experience to Box AP753, FOUNDRY TRADE JOURNAL.

MOULDER required for small non-ferrous foundry in home counties. Single man preferred; only those willing to work for advancement need apply. Excellent prospects for right man with experience, write full details to Box MR754, FOUNDRY TRADE JOURNAL.

SHOP MANAGER for Aluminium Die Foundry in the Midlands wanted. Experienced man, able to control, encourage and, if necessary, train labour. Four figure salary.—Box SM747, FOUNDRY TRADE JOURNAL.

ENGINEERS' AGENTS required for selling Centrifugal Castings in non-ferrous alloys, on commission basis. Company with increasing production requires sales of bearings, slip-rings, pressure-tight castings, etc., to Engineering concerns in Midlands, Wales, Lancashire, North-East Coast and Glasgow.—Applications to Box EA765, FOUNDRY TRADE JOURNAL.

DIE CAST FOUNDRY FOREMAN or SUPERINTENDENT required. Really first-class position for capable man. Midlands area.—Box DC766, FOUNDRY TRADE JOURNAL.

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WRITE to the SALES MANAGER marking envelope "PRIVATE" stating which position is being applied for, details of career to date and present salary.

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SITUATIONS VACANT—*contd.*

CHEMIST required for Steel Foundry. State age, experience, and salary required.—Apply ARCHIBALD BAIRD & SON, Ltd., Clyde Steel & Engineering Works, Hamilton.

FOUNDRY FOREMAN wanted; principally green sand. Excellent opportunity for young energetic craftsman, with some metallurgical qualification.—Apply GENERAL MANAGER, Hillside Foundry, Cupar.

MALLEABLE IRONFOUNDERS (Midlands) require first-class PRODUCTION MANAGER. Good salary for right man. Accommodation available if required. Pensionable appointment.—Full details of education, qualifications and experience, to Box M1775, FOUNDRY TRADE JOURNAL.

GENERAL MANAGER, to take complete charge of well-established Grey Iron Foundry, producing 200 tons small and medium castings per week. Salary up to £2,000 per annum to man of proved ability. —Write, giving full particulars in strict confidence, to Box GM777, FOUNDRY TRADE JOURNAL.

WORKING CHARGEHAND to start new Iron section in Non-Ferrous foundry, London Area. Must be fully experienced in all phases of Iron foundry practice. Write full particulars, Box WC786, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN is required in an East Anglian Foundry producing high quality ferrous and non-ferrous, light and medium weight castings, hand and machine moulding methods. Applicants must have good Technical knowledge together with sound practical experience; should be capable of ensuring proper training of apprentices and trainee labour. Salary and output bonus will be paid to successful applicant for whom accommodation can be arranged. Applications will be dealt with in the strictest confidence. Apply Box FF785, FOUNDRY TRADE JOURNAL.

DRAUGHTSMEN required. London Area fully experienced in the design and detailing of Mechanical Handling Projects. Salary £800 p.a. to start, and reviewed after three months. Must be capable of achieving £1,000 p.a. or more. Luncheon vouchers. Write to Box DR780, FOUNDRY TRADE JOURNAL.

ASSISTANT METALLURGICAL CHEMIST required for research and development work in connection with foundry materials. Good general education and some initial works laboratory experience desirable. Works located in the Midlands. Full details of age, education, experience, salary required, etc., to Box AM779, FOUNDRY TRADE JOURNAL.

ASSISTANT FOUNDRY FOREMAN required for repetition Grey Iron Foundry in the Birmingham area. Applicant must have had experience in controlling foundry labour. Permanent and progressive position for the right man. Apply, stating age, experience and salary required. Box AF784, FOUNDRY TRADE JOURNAL.

BRITISH RAILWAYS RESEARCH DEPARTMENT.—A vacancy for a SCIENTIFIC OFFICER, Grade 2, exists in the Metallurgy Division at Derby. Full salary range: £507-£798. Professional/Academic qualifications essential, and industrial experience in metallurgy an advantage. Superannuation and certain free travel facilities.—Applications to DIRECTOR OF RESEARCH (RAILWAYS), Staff Section, 222, Marylebone Road, London, N.W.1.

SITUATIONS VACANT—*contd.*

PATTERNMAKERS.—Experienced wood and metal. Constant employment. Canteen facilities. London area.—Apply Box PM772, FOUNDRY TRADE JOURNAL.

TECHNICAL REPRESENTATIVE required for Yorkshire by a well-known Company in the chemical/metallurgical industry. Applicants should be between 25 and 40, with practical foundry experience and/or metallurgical knowledge. An exacting post calling for a high standard of intelligence. Well paid, with prospects for advancement in return for hard work. Car supplied. Superannuation scheme.—Box TR771, FOUNDRY TRADE JOURNAL.

FOUNDRY FOREMAN required to take charge of Grey Iron Jobbing Foundry with a view to becoming Manager. Must have practical experience and be well versed in Foundry Craft and Practice. Apply in confidence, giving age, qualifications and salary required, to ECLIPSE FOUNDRY COMPANY (LEICESTER) LTD., Clarendon Street, Leicester. Telephone No. Leicester 20046.

CHIEF METALLURGIST with sound knowledge of grey iron, high duty and light alloys able to control labour and cupolas, required by large Foundry in Midlands with mechanized, semi-mechanized and floor moulding facilities. Give age, experience and salary required. Box CM783, FOUNDRY TRADE JOURNAL.

EXCELLENT opportunity for man 30-40 years, in Non-ferrous Foundry in the West of England. Progressive post, eventually leading up to Manager. Applicants should be experienced in controlling labour on production work, and must have sound knowledge of general Foundry moulding practice.—Write, giving full particulars, including salary required to Box EO776, FOUNDRY TRADE JOURNAL.

AGENCIES

AGENT required, one already calling on engineering trades South and London area, to acquire orders for Non-Ferrous Castings, on commission basis. Reply, giving details, to JUNCTION FOUNDRY, Myrtle Road, Folkestone.

REPRESENTATIVES required calling on Foundries to sell low priced efficient Core Sand Mixer and used Core Reclaimer, numbers already installed in important foundries. High commission paid. Box RR767, FOUNDRY TRADE JOURNAL.

AN old-established firm in the Midlands wishes to appoint an AGENT to sell their products as an extra line to Foundries in Scotland. Only those with first class connection with Foundries considered. Box AO778, FOUNDRY TRADE JOURNAL.

FINANCIAL

AN interest is available in small non-ferrous foundry which is expanding, home counties area, to young energetic man with capital and experience. Principals only. Write Box AI755, FOUNDRY TRADE JOURNAL.

FOUNDRIES FOR SALE

SMALL Jobbing Iron Foundry in North Yorks town for sale or to let. Good continuity orders assured. All propositions considered.—Write Box SJ742, FOUNDRY TRADE JOURNAL.

FOUNDRIES FOR SALE—*contd.*

FOUNDRY for disposal, South Wales. Ferrous and Non-ferrous. Compressed Air, Electrics, Gas and Oil Installation. Mechanically charged Cupolas, approx. 10,000 sq. ft. Rental £350 p.a. £3,000 for quick sale.—Box FF773, FOUNDRY TRADE JOURNAL.

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